

Ear & Hearing Center at
Texas Children's Hospital®

Dear Families,

Welcome to the Cochlear Implant Program at Texas Children's Hospital! Our goal is to provide comprehensive, specialized care for children with severe hearing loss, and help them achieve the best possible communication outcomes. Since our program started in 2001, we have performed more than 700 implants.

Your child may be a candidate for a cochlear implant in one or both ears. Cochlear implants, or CIs, are innovative devices which can directly stimulate the auditory nerve and provide access to sound in children with severe or profound hearing loss. The decision about whether to recommend a CI is highly individualized, and requires the input of specialists in multiple areas, including Otolaryngology, Audiology, Speech Pathology, and Neuropsychology, among others. These specialists make up the members of the Cochlear Implant Team. They work in close collaboration to determine who is a candidate for a CI, perform the implantation surgery, and help patients through the rehabilitation afterwards.

This guide will help you understand the entire process, who may be considered a CI candidate, the basics of how the device works, how the surgery is done, and the necessary rehabilitation to achieve a successful outcome.

Thank you for the opportunity to help your family through this journey. All of our team members are dedicated to helping children with hearing loss achieve their full potential. If you have any questions or concerns, please do not hesitate to contact us.

Sincerely,

The Cochlear Implant Team at Texas Children's Hospital



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 - *Attending every appointment is important*
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 - Tells you some of the factors considered
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Section 1

How We Hear

The auditory system, or hearing system, keeps us connected to our world 24 hours a day. This system **never turns off!** Even when we are asleep, the auditory system is working. The auditory system consists of the ears, auditory pathways, and the **brain**. It is the **brain** that gives those sounds meaning.

Outer Ear

- Pinna
- Auditory canal

Middle Ear

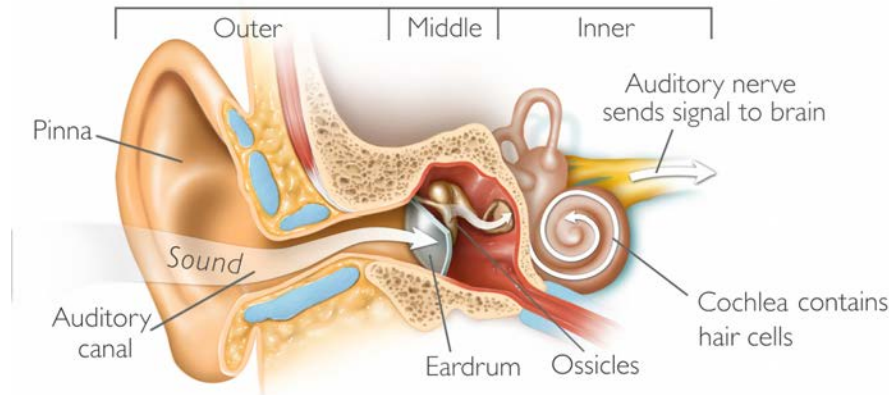
- Eardrum
- Ossicles – 3 little bones

Inner Ear

- Round window
- Cochlea – responsible for hearing
 - Fluid filled, snail-shaped structure
 - Contains sensitive hair cells
 - Hair cells are sensitive to specific frequencies
 - High frequency sounds are stimulated at the base of the cochlea
 - Low frequencies sounds are stimulated at the tip
- Semicircular canals – responsible for balance
- Auditory nerve

Central Auditory System

- Auditory Pathway
- Brain



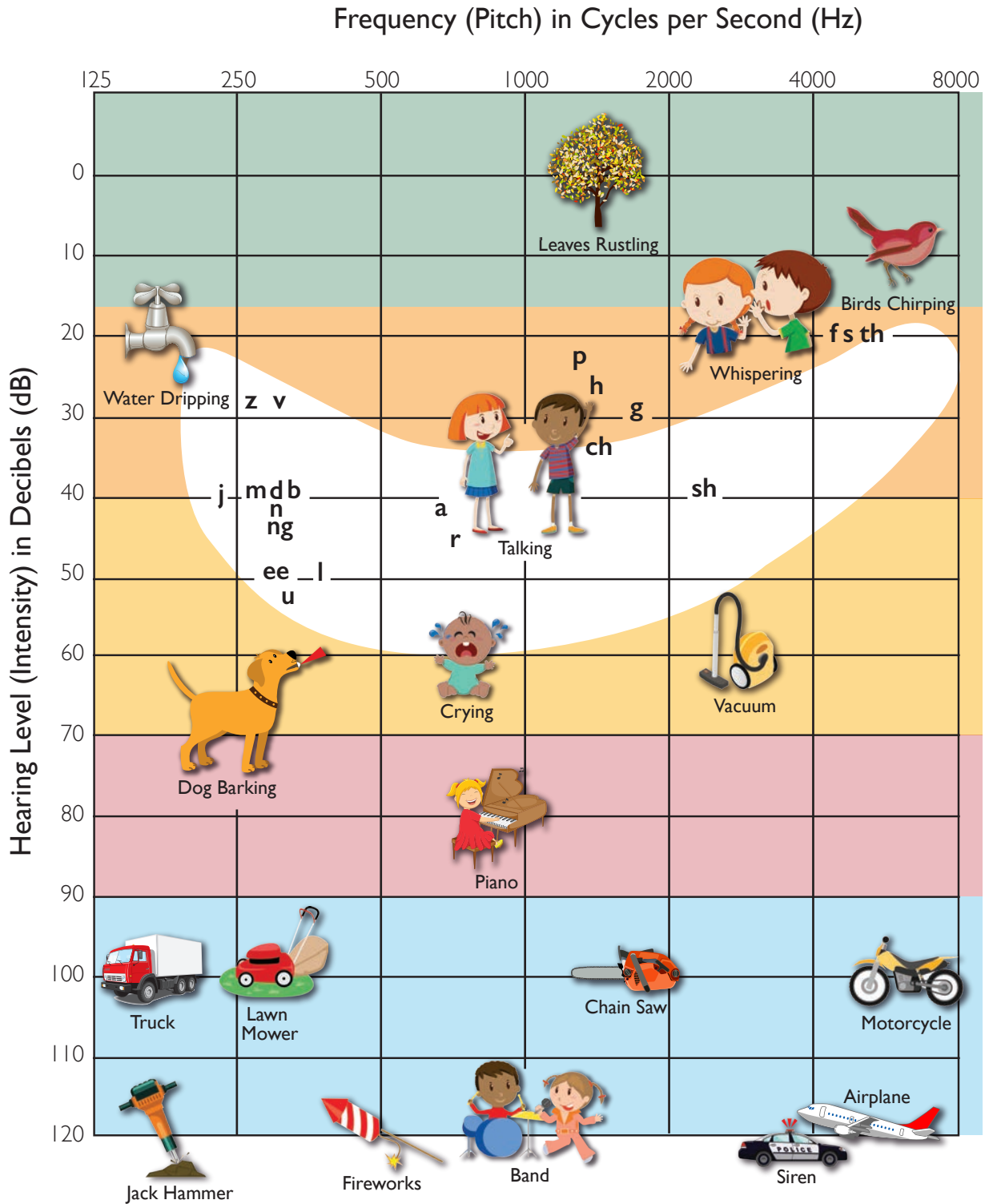
HOW HEARING WORKS

- The pinna collects sound waves and funnels them into the auditory canal.
- The auditory canal amplifies the sounds.
- These vibrations make the eardrum vibrate.
- The ossicles connect to the eardrum. As the eardrum vibrates, the ossicles begin to move.
- The ossicles' movement creates enough force to move the fluid inside the cochlea.
- The movement of the fluid creates movement of the hair cells.
- The movement of the hair cells creates impulses that fire the auditory nerve.
- The auditory nerve moves up the auditory pathway to the auditory cortex of the brain.
- The brain then processes the sound for meaning.

Section 2

Audiogram of Familiar Sounds

An audiogram is a graph that shows at what intensity (decibel, dB) you can hear different sound pitches (Hertz, Hz). Audiometric testing will compare your child's results to other children with normal hearing.



Degree of Hearing Loss	Decibels (dB HL)	Sound Examples	Communication Concerns
Normal Hearing	0-15 dB HL	Rustling of leaves	Will hear speech and language clearly.
Mild	16-40 dB HL	Quiet/whispered speech	Difficulty hearing soft speech especially in noisy areas.
Moderate	41-55 dB HL	Normal conversational speech	Difficulty hearing speech clearly especially at a distance, in background noise, and when speaker is not facing the child.
Moderately-Severe	56-70 dB HL	Normal to loud speech, vacuum cleaner, baby crying	Difficulty hearing speech clearly especially at a distance, in background noise, and when speaker is not facing the child.
Severe	71-90 dB HL	Loud shouting, dog barking	May hear loud voices up close but continue to have difficulty understanding speech even with hearing aids. May need a cochlear implant to understand speech.
Profound	≥91 dB HL	Airplane, chainsaw, fireworks	Difficulty understanding speech with hearing aids. May need a cochlear implant to understand speech.

dB HL = Decibels Hearing Level

If hearing loss is diagnosed in one or both ears, it can be further classified based on how severe it is. Children with severe or profound hearing loss may be cochlear implant candidates.

Section 3

Cochlear Implant Basics

When hearing loss is caused by dysfunction of the inner ear (damaged hair cells or auditory nerve) it is called sensorineural hearing loss (SNHL). It is the most common type of hearing loss. SNHL is often irreversible because hair cells cannot be repaired once damaged.

A cochlear implant is an amazing hearing device that bypasses the impaired hair cells. A cochlear implant is different from a hearing aid.

HOW HEARING AIDS WORK

- Make sounds louder
- Sounds still have to travel through an impaired inner ear, specifically the hair cells of the cochlea
- Hearing aids can help by making sounds louder but if hearing loss is very severe, the volume and the quality of the sound may not be enough for adequate language development and communication.



HOW COCHLEAR IMPLANTS WORK

- Bypass the damaged hair cells
- Stimulate the auditory nerve directly

A cochlear implant may be a good choice for your child when hearing loss is severe to profound

- If hearing aids provide little acoustic benefit
- If listening and talking is the desired communication outcome
- If the inner ear anatomy supports this technology



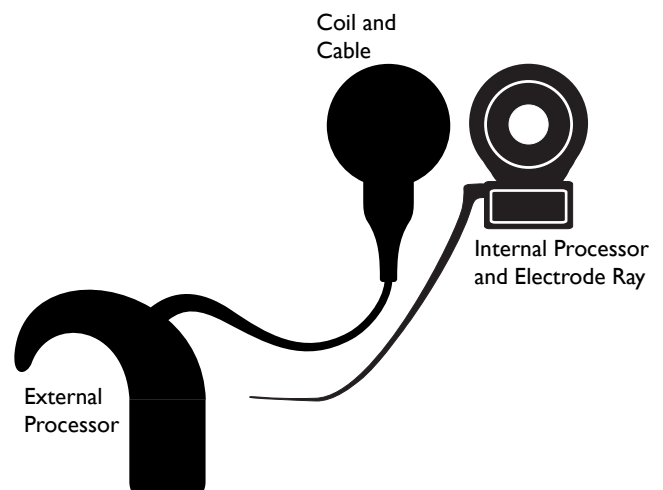
Parts of a Cochlear Implant:

All manufacturers have similar parts.

- A. External Processor
- B. Coil and Cable
- C. Internal Processor and Electrode Array

To see how a cochlear implant works watch this video

<http://blausen.com/en/video/cochlear-implants/>



Section 4

The Doctors, Specialists and Tests that are part of the Cochlear Implant Process

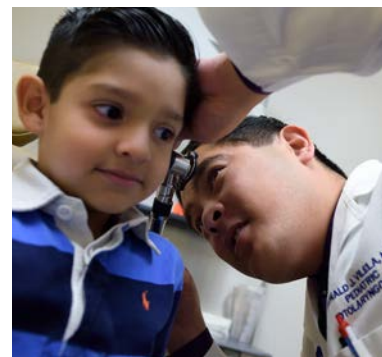
WHY DOES MY CHILD NEED ALL OF THESE APPOINTMENTS?

- Candidacy for a cochlear implant requires the input from several specialized professionals working as a team.
- These visits and tests give important information to understand if a CI can benefit your child.
- Not all children need all of these visits/tests. Your doctor will tell you the ones needed.

WHAT ARE THE APPOINTMENTS? WHAT WILL I LEARN?

ENT (Ear, Nose and Throat) Appointments – An ENT will:

- Review all relevant medical testing and results of prior evaluations
- Assess the structures of the ears by completing an exam in the office and review the results of imaging such as MRI and/or CT to determine if the inner ear structures are able to support a CI
- Recommend other testing as needed
- Discuss risks, benefits and expectations of surgery



Audiological Evaluations – An Audiologist will:

- Diagnose hearing loss, specifying the type and severity
- Perform proper fitting of hearing aids, which provide amplification of sound
- Test and monitor performance of the child's hearing with and without hearing aids with follow-up testing



IMPORTANT – It may take several visits to get all of the information needed.
The child must wear hearing aids to all appointments.

Before we can determine whether a child is a candidate for cochlear implants, hearing aids must be used for a minimum of 3 months as required for a trial period.

Speech-Language Evaluation – A Speech-Language Pathologist who specializes in children with hearing loss is also called an Audiology-Verbal Therapist (AVT) will:

- Assess your child's current hearing, speech and language skills
- Provide education and counseling to understand how a CI can benefit your child
- Make recommendations and develop a plan of care
- Provide therapy services before obtaining a CI as part of the hearing aid trial



IMPORTANT – It may take several visits to get all of the information needed.
The child must wear hearing aids to all appointments.

ADDITIONAL EVALUATIONS

A Program Coordinator will: be your main point of contact with our program, assist with the scheduling and coordination of appointments, gather records from other facilities, and make sure that all evaluations are completed in a timely manner, among other responsibilities.

MRI and/or CT Scans – These tests will:

- Show the physician the inner ear, auditory nerve and related structures

ECG – This test will:

- Assess your child's heart activity

Genetics Evaluation – A Genetics Health Provider may:

- Investigate genetic reasons for hearing loss

Neuropsychology – A Neuropsychologist will:

- Assess your child's overall development.
- Assess your child's ability to learn
- Include caregivers in the testing. Support is **critical** to the child's success with a cochlear implant

Ophthalmology Consult – An Ophthalmologist will:

- Assess your child's vision.

Social Work – A Social Worker will:

- Provide emotional support and community resource guidance for caregivers during the process
- Provide resources for lodging and transportation assistance (based on insurance benefits).

An Insurance Specialist will:

- Verify insurance coverage for CI surgery.

VACCINATIONS

It is known that children with severe hearing loss and cochlear implants are at a higher risk of contracting meningitis. Meningitis is an infection that causes serious and possibly life-threatening inflammation of the brain and spinal cord. It is caused by either a virus or bacteria. Vaccinations against *Streptococcus pneumoniae* reduces that risk.

If your child is younger than 24 months, please consult your pediatrician or health provider to ensure the child is up-to-date on all routine vaccinations, particularly **Pevnar 13 (PCV 13)**.

If your child is 24 months or older, the **Pneumovax 23 (PPSV 23) vaccine** is recommended by the Centers for Disease Control and Prevention (CDC). If your child is found to be a CI candidate, this vaccine should be administered by your pediatrician 4 to 6 weeks prior to surgery or 4 to 6 weeks after surgery.



Section 5

Cochlear Implant Candidacy Criteria

TO GET A COCHLEAR IMPLANT, YOUR CHILD MUST:

1. Be diagnosed with either
 - a. A severe to profound sensorineural hearing loss (SNHL)
or
 - b. Auditory neuropathy spectrum disorder (ANSD)

2. Be enrolled in:
 - a. Speech therapy that focuses on the development of **listening** and spoken language skills
 - b. Auditory impairment (AI) services

3. Be evaluated by the following Texas Children's Hospital CI team members:
 - a. Otolaryngologist (Ear, Nose and Throat, or ENT, surgeon)
 - b. Auditory-Verbal Therapist
 - c. Cochlear Implant Audiologist
 - d. Neuropsychologist – if decided by your ENT
 - e. Others as recommended

4. Have used hearing aids for at least 3 months with limited success
The team will assess aided benefit using audiological testing and listening performance in daily activities

5. Have an inner ear (cochlea) and auditory nerve that supports the internal components of the cochlear implant

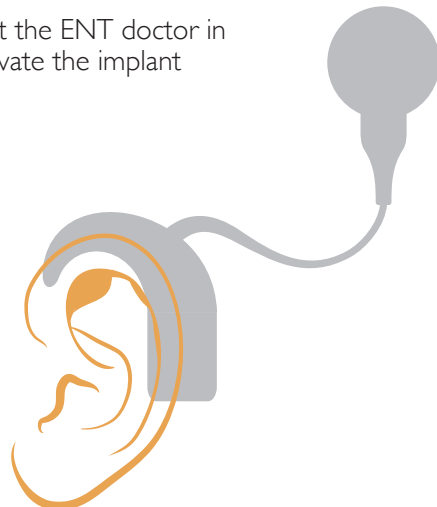
6. Have caregiver support and realistic expectations
All of the evaluations will help the cochlear implant team estimate what the cochlear implant(s) can do for your child. Every child's expected benefit with a cochlear implant is different. For some, the expected benefit is to learn, listen and speak as well as their age-matched hearing peers. For others, the expected outcome may be improved quality of life through enhanced sound awareness.

Section 6

Pathway to a Cochlear Implant



- 1** Screen for hearing loss
- 2** Visit ENT doctor to discuss options
- 3** Start hearing aid trial & auditory-verbal therapy
- 4** Continue hearing testing & auditory-verbal therapy
- 5** Complete additional evaluations (MRI/CT, neuropsychology, genetics, as needed)
- 6** Cochlear implant team meets to determine best option for each child based on results and progress
- 7** If cochlear implant is recommended, surgery for implant is scheduled & performed
- 8** Two to four weeks after surgery, visit the ENT doctor in the office and the audiologist to activate the implant
- 9** Continue audiologist visits for programming and fine tuning, along with ongoing auditory-verbal therapy
- 10** Visit ENT doctor as scheduled and continue speech therapy



Section 7

Audiology Mapping and ENT Appointment Schedule

1

2 to 4 Weeks After Implantation

2a

Appointment with surgeon to check surgical site.
If schedule allows, coordinated appointment for cochlear implant
activation with Audiology (2-hour appointment)



2b

Next Day

Second appointment with audiology for cochlear implant mapping
(1-hour appointment)



3

One Week Later

Third appointment with audiology for cochlear implant mapping
(1-hour appointment)



4






Monthly Appointments

Mapping appointment with audiology for cochlear implant adjustments
(1-hour appointments)

Section 8

Overview of Cochlear Implant Manufacturers

Cochlear Implant Manufacturer Quick Facts

Manufacturer	Advanced Bionics	Cochlear	Med-El
Website	www.advancedbionics.com	www.cochlear.com	www.medel.com
Customer Service	877-829-0026	800-523-5798	888-633-3524
Sound Processors	<p>Naida</p>  <p>Neptune</p> 	<p>Cochlear Nucleus 6</p> 	<p>Sonnet</p>  <p>Rondo</p> 
Number of Channels	16 (120 virtual channels)	22	12 (up to 250 spectral bands)
Number of Program Slots	5 (Naida); 3 (Neptune)	4	4
Internal Device Warranty	10 years	10 years	10 years
Sound Processor Warranty	5 years	5 years	5 years
MRI Compatibility	1.5 and 3.0 Tesla with magnet removed	1.5 Tesla with and without magnet	1.5 and 3.0 Tesla with and without magnet
Water-Wear Options	Neptune processor; Naida processor with Aqua Case	Aqua +	With waterproof sleeve
Streaming, FM Compatible, & Remote Control Access	Yes	Yes	Yes

Section 9

Yearly Maintenance Appointments

After your child gets the cochlear implant, the following appointments are needed in addition to regular Auditory-Verbal Therapy. These appointments help to make sure your child makes the expected progress.

APPOINTMENTS INCLUDE:

1. Audiology

To make an appointment call:

Texas Medical Center: 832-822-3249

The Woodlands: 832-227-1420

West Campus: 832-227-1030

2. ENT Surgeon

Prescriptions are necessary to get replacement cochlear implant equipment and batteries. Your cochlear implant surgeon must see your child in order to write prescriptions. Your child should see the ENT at least one time a year.

To make an appointment, call:

Texas Medical Center: 832-822-3250

The Woodlands: 936-267-7400

West Campus: 832-227-1420

3. Speech And Language Re-evaluation

Evaluations to take place at least every 12 months but preferably every 6 months after implantation.

Therapists trained in Auditory-Verbal techniques will:

- Assess progress in listening, speech, and language
- Provide updated recommendations and goals

To make an appointment, call:

The Woodlands: 936-267-7250

West Campus: 832-227-1900

4. Neuropsychology Re-evaluation

Your child should be seen one year after getting the cochlear implant. This doctor will:

- Assess progress with the cochlear implant
- Provide recommendations for continued development

To make an appointment:

Request a cochlear implant follow-up appointment with Audrey M. Carson, PhD: 832-822-3700

Section 10

Resources

COCHLEAR IMPLANT COMPANIES

- Advanced Bionics
www.advancedbionics.com
- Cochlear Americas
www.cochlear.com
- Med-El
www.medel.com

INFORMATION ABOUT HEARING LOSS IN CHILDREN

- Alexander Graham Bell Association for the Deaf and Hard of Hearing
www.agbell.org
- All Ears
www.allearscenter.org
- Hearing First, Powering Potential
www.hearingfirst.org
- Hearing Loss Association of America
www.hearingloss.org
- John Tracy Clinic
www.jtc.org
- Laurent Clerc National Deaf Education Center, Gallaudet University
www.clerccenter.gallaudet.edu
- Navigating a Forest of Information; One tree at a time
www.gallaudet.edu/documents/clerc/ci.pdf
- Success for Children with Hearing Loss
www.successforkidswithhearingloss.com
- Texas Hands and Voices
www.txhandsandvoices.org
- The Center For Hearing and Speech and the Melinda Webb School in Houston
www.centerhearingandspeech.org
- The Listening Room – Hearing Journey
www.hearingjourney.com