INTRODUCTION

- Cochlear implant candidacy criteria evolved dramatically since multichannel implants were first approved by the FDA.
- Initially, only individuals with bilateral profound SNHL with no open set speech recognition were considered candidates for cochlear implantation.
- These criteria have become less stringent over time.
The evaluation process is a team approach:
- Audiologist
- Speech and language specialists
- Social worker
- Educational consultant
- Operating surgeon
<table>
<thead>
<tr>
<th>1985</th>
<th>1990</th>
<th>1998</th>
<th>Today</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age of Implantation</strong></td>
<td>Adults age 18 or older</td>
<td>Adults &amp; Children age 2 years or older</td>
<td>Adults &amp; Children age 12 months +</td>
</tr>
<tr>
<td><strong>Onset of Hearing Loss</strong></td>
<td>Postlinguistic</td>
<td>Postlinguistic Adults &amp; Pre/Postlinguistic Children</td>
<td>Pre/Postlinguistic</td>
</tr>
<tr>
<td><strong>Degree of SNHL</strong></td>
<td>Profound</td>
<td>Profound</td>
<td>Severe-to-Profound</td>
</tr>
<tr>
<td><strong>Adult Speech Scores</strong></td>
<td>0%</td>
<td>0%</td>
<td>40% or less sentences in quiet</td>
</tr>
<tr>
<td><em>(open–set)</em></td>
<td></td>
<td></td>
<td>50% on sentences in quiet in ear to be implanted, with 60% or less in contralateral ear or binaurally</td>
</tr>
<tr>
<td><strong>Pediatric Speech Scores</strong></td>
<td>N/A</td>
<td>0%</td>
<td>Lack of auditory progress, Less than 20% pediatric word tests</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Lack of auditory progress, 30% or less on pediatric word tests</td>
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</table>

**ADULT IMPLANT CANDIDACY CRITERIA**

1-Audiometric threshold:

- CI manufacturers specify bilateral **severe-to-profound** SNHL for adult implant candidacy.

- Recently, individuals with **mild to moderate low frequency** hearing with absent high frequencies are considered candidates for cochlear implantation using EAS.

(Gifford, 2011)
ADULT IMPLANT CANDIDACY CRITERIA

Due to evolutions in surgical techniques; safer cochleostomy, atraumatic electrode insertion and the use of perimodilar electrodes; residual hearing can be preserved.

2-Speech recognition scores:

- Advanced Bionics specified sentence recognition up to 50 % in the best aided condition.
- Cochlear specified sentence recognition up to 50 % correct in the ear to be implanted and to 60 % in the best aided condition.
- Med El listed sentence recognition up to 40 % correct in the best aided condition.

(Gifford, 2011)
ADULT IMPLANT CANDIDACY CRITERIA

The implant companies recommended a test battery for pre- and post-implant assessment of performance which includes AzBio sentences, BKB-SIN, and CNC monosyllabic words.

A test battery consisting of words, sentences in quiet and in noise provides information on an individual’s performance in a variety of listening conditions and allows for cross-checking scores.

(Gifford, 2011)

ADULT IMPLANT CANDIDACY CRITERIA

The recommended presentation level is 60 dB SPL in the sound field, the average conversational speech levels. (Pearsons et al., 1978)

Post-implant speech recognition was essentially identical for 60 and 70 dB SPL, but that pre-implant performance was significantly poorer for 60 dB SPL as compared to 70 dB SPL. (Firszt et al., 2004)
ADULT IMPLANT CANDIDACY CRITERIA

- A CI should also be proposed when speech discrimination is higher but exhibits marked rollover.

- **Rollover** is a drastic drop of the score at sound intensities 10 dB higher and lower than the intensity at which the maximum score is obtained.

ADULT IMPLANT CANDIDACY CRITERIA

- Just as important as presenting speech stimuli **without visual cues** is the presentation of **recorded materials** for the assessment of speech recognition abilities.

- Comparison of monosyllabic word recognition using both recorded stimuli and monitored live voice, showed MLV scores were significantly higher in every case. (Roeser & Clark, 2008)
PEDIATRIC IMPLANT CANDIDACY CRITERIA

1-Age:

- In 2002, the FDA lowered the recommended age requirement to **12 months** of age. The child must weigh about 9-10 Kg from an anesthesia viewpoint.
- The FDA recommended age is not legally binding.
- Specific circumstances may allow for earlier implantation. A child with *meningitis* is implanted as early as possible as this condition causes cochlear ossification.  

(Gifford, 2011)

- The CI should be implanted as early as possible to decrease the duration of auditory deprivation and its deleterious effects on the auditory pathways.

Adopted from Sharma et.al. 2007
Children implanted before the age of 5, with time and rehabilitation, develop very good speech understanding as well as speech production skills. The majority of these children are able to attend mainstream schools.

2-Audiometric threshold:

For children aged 12 to 24 months, the current criteria specify bilateral profound SNHL.

The greatest concern was that establishing behavioral thresholds was most difficult for the youngest children; thus the criteria for the youngest candidates happen to be most stringent.

(Gifford, 2011)
For children **2 years** of age and older, current audiometric criteria include bilateral **severe-to-profound** SNHL.

However, if a child has less severe SNHL and is not making auditory **progress** with full-time use of well-fitted hearing aids and recommended intervention, referral for a CI evaluation is appropriate.

(Gifford, 2011)

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**3-Auditory progress with hearing aids:**

- During the hearing aid trial (**3 months** period), children should be making at least **month-to-month** auditory progress as well as speech and language developmental progress.
- Regular **speech therapy** should be considered a part of the hearing aid trial for all children being seen for implant evaluations.

(Gifford, 2011)
Auditory skills are generally assessed via parental history and administration of validated questionnaires designed to gauge auditory-based responsiveness to speech and sounds in a child’s environment (e.g. IT-MAIS).

(Gifford, 2011)

4-Speech recognition scores:

For older children is generally based upon either mono- or multi-syllabic word recognition depending on the child’s development.

The cochlear implant manufacturers lists include the ESP, the Multisyllabic Lexical Neighborhood test, the Lexical Neighborhood Test, the Phonetically Balanced Kindergarten (PBK) word recognition test and HINT-C.

(Gifford, 2011)
PEDIATRIC IMPLANT CANDIDACY CRITERIA

- FDA pre-implant word recognition performance candidacy criteria for older children, ranges from 12-30% correct in the best aided condition.

(Grifford, 2011)

OTHER CANDIDACY CRITERIA

- Family willingness to follow recommendations; enroll in speech, language, and auditory therapy; and return for follow-up appointments.
- Educational and home environments that are supportive of cochlear implants.
- Having no medical contraindications to electrode insertion or receiver placement. Otitis media must be diagnosed and managed prior to implantation. Prior ear or posterior fossae surgery must be investigated preoperatively.
PREREQUISITES FOR CI

► **Inner ear malformations** are easily visualized on CT and MRI.

► Results may alter the choice of side of implantation or raise other issues such as electrode selection.

► CT scanning remains the gold standard and is done to ensure normal cochlear anatomy and patency, and to assist with surgical planning and to reduce surgical risk.
MRI shows the cochlear fluid signal. It is very useful in identifying early labrynthitis ossificans, which typically begins with endoluminal fibrosis of the scala tympani at the basal turn.

MRI can rule out vestibular schwannoma (NF type II) and AN aplasia.

In case of a Mondini dysplasia, an isolated LVA, or partial semicircular canal aplasia, outcome is generally favorable.
On the other hand, in case of total semicircular canal aplasia, incompletely partitioned cochlea, cochlear hypoplasia or common cavity, performance levels are generally poor.

Patients with cochlear malformations may require:

- A different type of electrode
- A different surgical approach (drill out)
- Extra precautions for the increased risk of meningitis or cerebrospinal fluid gusher.

Families and patients must be fully informed about the variable performance of these patients and the potential risks.
Pediatric and adult patients with cochlear implants are at increased risk of acquiring *S. pneumoniae meningitis*. (Reefhuis et al. 2003)

In 2002, the CDC issued age-appropriate immunization guidelines for patients who are going to be the recipient of a cochlear implant to be completed at least **2 weeks** before surgery.
In 2008 the Guidelines and Development Conference on the Identification and Management of Children with AN, recommended that CI be considered as a treatment option in AN in the event of poor progress in auditory language development and speech understanding, regardless of behavioral audiometric thresholds.

Even assuming that the site of lesion is central, there are still reasons to consider the idea that CI might be an effective intervention in AN.

The discrete biphasic pulses used in most cochlear implant stimulation strategies may assist in increased synchrony of the firing pattern of the auditory nerve. (Rance, 2005)
Multiple reports in the literature describe performance of CI recipients with AN to be comparable to that of the general population with cochlear implants. (Buss et al., 2002; Madden et al., 2002; Rodriguez Ballesteros et al., 2003; Zdanski et al., 2006)

There have been reports that have detailed the scores of outcome measures that show improvement over preimplantion performance. (Mason et al., 2003)

Caution should be exercised in AN cases because:

1. Cochlear nerve deficiency (small or absent nerve) has been reported in many auditory neuropathy cases. MRI is crucial in these cases. (Buchman et al., 2006; Walton et al., 2008)

2. Some infants and young children with AN show evidence of spontaneous improvement in hearing within the first 15 months after diagnosis. (Madden et al., 2002)
DEAF MUTE INDIVIDUALS

- For those who were educated with manual language, and live in the deaf community CI has been very controversial.
- **Good lip readers**, who have some spoken language skills, CI may provide significant benefit.
- These users report better communication with hearing family and friends, better use of environmental sounds, and improvement in QOL.

ADDITIONAL DISABILITIES

- 30% of hearing-impaired children have another disability in addition to their hearing impairment.
- Blindness, motor disturbances, epilepsy, skeletal malformations, etc., were not implanted in the past.
ADDITIONAL DISABILITIES

- Nowadays, associated disabilities per se do not exclude a child from implantation if conventional hearing aids do not help and if the child is believed to merit from the implant.

- No definite temporal connection was found between cochlear implant use and seizure activity. (Shingal et al., 2011)

CONTRAINDICATIONS FOR CI
ABSOLUTE CONTRAINDICATIONS

1- Absence of the eighth nerve

2- Cochlear agenesis (Michel’s aplasia).

3- A child who has significant residual hearing levels and receives good benefit from traditional hearing aids.

RELATIVE CONTRAINDICATIONS

1- Children who obtain substantial access to sound using state-of-the-art technology of digital HAs.

2- Children that use sign language as their main mode of communication.

3- Severe emotional, behavioral, or cognitive delays that prevent participation in the educational/training programs.
CHOICE OF THE IMPLANTED EAR

- In general, after implantation, the residual hearing is lost and patients are no longer able to use a hearing aid for sound awareness, so the worst hearing ear is usually implanted.

- If the residual hearing is comparable in each ear, the ear with the acquired loss, shortest duration of deafness, or the longest use of hearing aid is preferred.
Thank you