

International survey of cochlear implant candidacy

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Abstract

The goal of this work was to determine International differences in candidacy based on audiometric and speech perception measures, and to evaluate the information in light of the funding structure and access to implants within different countries.

An online questionnaire was circulated to professionals in 25 countries. There were 28 respondents, representing the candidacy practice in 17 countries.

Results showed differences in the funding model between countries. Unilateral implants for both adults and children and bilateral implants for children were covered by national funding in approximately 60% of countries, (30% used medical insurance, and 10% self-funding).

Fewer countries provided bilateral implants routinely for adults: national funding was available in only 22% (37% used medical insurance and 41% self-funding). Main evolving candidacy areas are asymmetric losses, auditory neuropathy disorders and electro-acoustic stimulation.

For countries using speech-based adult candidacy assessments, the majority (40%) used word tests, 24% used sentence tests and 36% used a mixture of both. For countries using audiometry for candidacy (70-80% of countries), the majority used levels of 75-85 dB HL at frequencies above 1 kHz. The United Kingdom and Belgium had the most conservative audiometric criteria, and countries such as Australia, Germany and Italy were the most

26 lenient. Countries with a purely self-funding model had greater flexibility in candidacy
27 requirements.

28 **Introduction**

29 The criteria for cochlear implant (CI) candidacy in both children and adults are known to
30 have considerable variation between countries and also between some regions within
31 countries. Recent UK research (Lovett et al, 2015; Vickers et al, 2015) looking at candidacy
32 for bilateral implants in children suggests that the current audiometric candidacy criteria
33 (equal to or greater than 90 dB HL at 2 and 4 kHz) may be too strict. Based on this research it
34 may be more appropriate to relax the criteria to be greater than or equal to 80 dB HL at 2 and
35 4 kHz. In countries such as Australia and Germany, there is a much more relaxed
36 audiometric cut-off level that allows all potential candidates to be identified audiometrically.
37 Subsequently clinical observation and assessment of likely outcome are used to determine if
38 individual candidates are making appropriate progress with their hearing aids, and whether
39 they would likely to gain more benefit with implants. Leigh et al (2011) recommended that
40 the audiometric criteria for Australia should be set at 70 dB HL four-frequency average (0.5,
41 1, 2 & 4 kHz) based on outcome comparisons with hearing aid users.

42

43 With technological improvements in implants in recent years, and changes in surgical
44 techniques that have improved the preservation of residual hearing, implant outcomes have
45 improved (Blamey et al., 2013). All the CIs that are available today are able to provide
46 additional acoustic amplification for any preserved natural hearing, together with the
47 electrical delivery of sound through the implant itself, making implants a viable intervention
48 for individuals with low-frequency residual hearing.

49 There is considerable variation at an international level, not only in the criteria for
50 implantation, but also in access to CIs, including access to funding, both for adults and

51 children (De Raeve and Wouters, 2013; Liang and Mason, 2013; Oliver, 2013; Raine, 2013;
52 Sorkin, 2013), and this could be affected by the model of service delivery and funding as well
53 as cultural and language aspects.

54
55 The goal of this article was to evaluate the differences in CI candidacy for both adults and
56 children across different regions of the world, in the context of the variation in approaches to
57 funding and models of service delivery found in individual territories.

58

59 **Method**

60

61 A questionnaire was developed to gather information on the following 4 topics:

62

- 63 1. Methods of funding for unilateral and bilateral implants
- 64 2. The presence or absence of specific guidelines, or criteria, to which teams are obliged to
65 comply. The categories were based on evaluations and aetiological factors, for example: pure
66 tone audiometry (PTA); speech perception tests (in quiet or in noise); duration of deafness;
67 onset of deafness; age of the candidate; aetiology of deafness; presence of other disabilities;
68 any other relevant factors.
- 69 3. Specific factors that can exclude implantation
- 70 4. Whether there is flexibility within the system that might allow a centre to implant someone
71 falling outside the programme's standard criteria.

72

73 The questionnaire was only available in English and was therefore written in a simple and
74 clear way to aid understanding for those for whom English is not their first language. The
75 questions used in the questionnaire are shown in appendix 1.

76

77 The questionnaire went through two stages of validity review prior to circulation. Initially the
78 members of the British Cochlear Implant Group (BCIG) working group on candidacy
79 reviewed the first version of the questionnaire to ensure that the questions appropriately
80 addressed the associated topic headings and could be analysed effectively to answer the
81 research questions. The second stage was to send the questionnaire to a group of five
82 experienced clinicians to determine if the questionnaire was clear and easy to complete.

83

84 The questionnaire was modified following the validation stages and then implemented as an
85 online questionnaire in the University College London (UCL) OPINIO software. The link
86 was sent out initially to 75 professionals working in CI clinics in 25 countries, and then
87 further distributed to the member states of Euro-CIU the European CI Users association, for
88 distribution to clinicians within their countries.

89

90 The questionnaire was open for completion for one calendar month.

91

92 **Results**

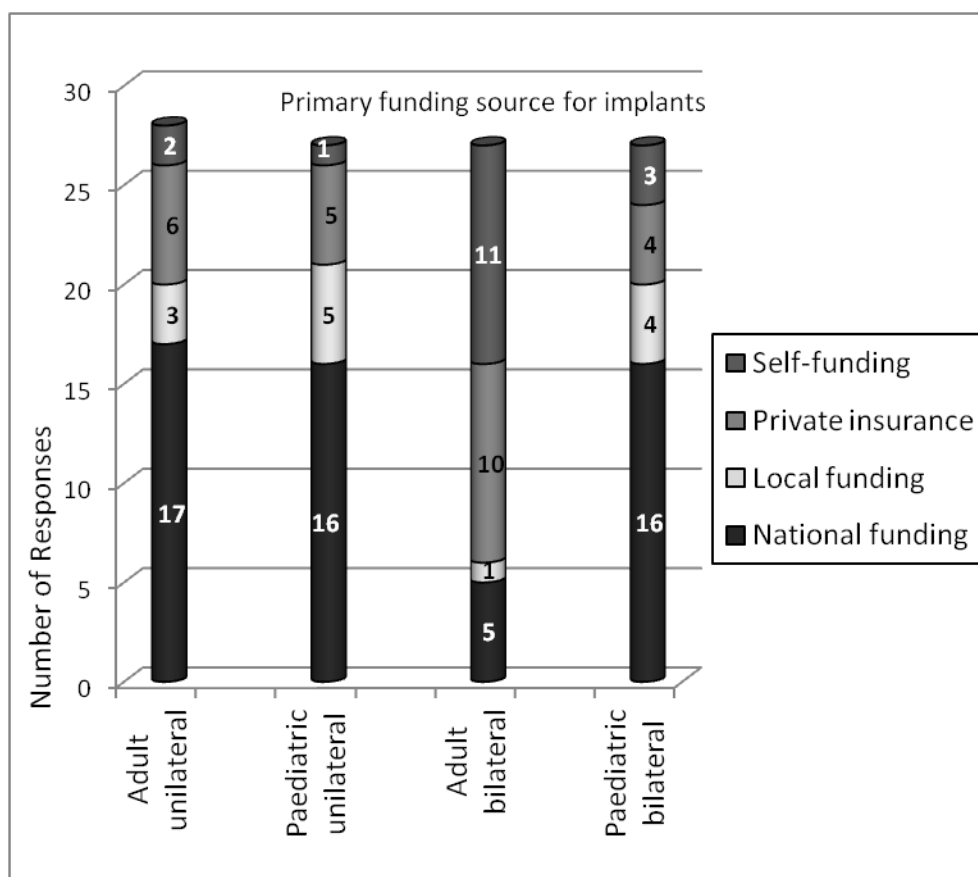
93 In total 28 respondents completed the questionnaire, representing 17 countries: Argentina,
94 Australia, Belgium, Bosnia Herzegovina, Brazil, Finland, Germany, India, Italy, The
95 Netherlands, New Zealand, South Africa, Spain, Switzerland, Portugal, United Kingdom, and
96 The United States of America. One centre was purely adult and another purely paediatric so
97 they were unable to answer all of the questions relating to adult or paediatric guidelines. The
98 results will be reported according to the four main subject areas.

99

100 *Funding for unilateral and bilateral implants*

101 Figure 1 shows the primary source of funding for unilateral and bilateral CIs for adults and
 102 children. All territories had a mixed model of funding but this figure shows the main route
 103 for funding for the majority of implantations in the country.

104



105

106 Fig 1. A stacked bar chart indicating the main source of funding for implants in a specific
 107 region, separated according to adult and paediatrics and also unilateral and bilateral implants.
 108 Each shaded section relates to the number of respondents that reported a specific outcome
 109 and the numbers indicate the exact number of respondents giving that response.

110

111 A similar pattern is observed for adult and paediatric unilateral and paediatric bilateral
 112 implantation, the breakdown of the specific numbers by category are shown in figure 1. The
 113 results show that for approximately 60% of territories the funding was provided nationally.
 114 Approximately 30% of countries receive funding from a local provision at a clinic or regional

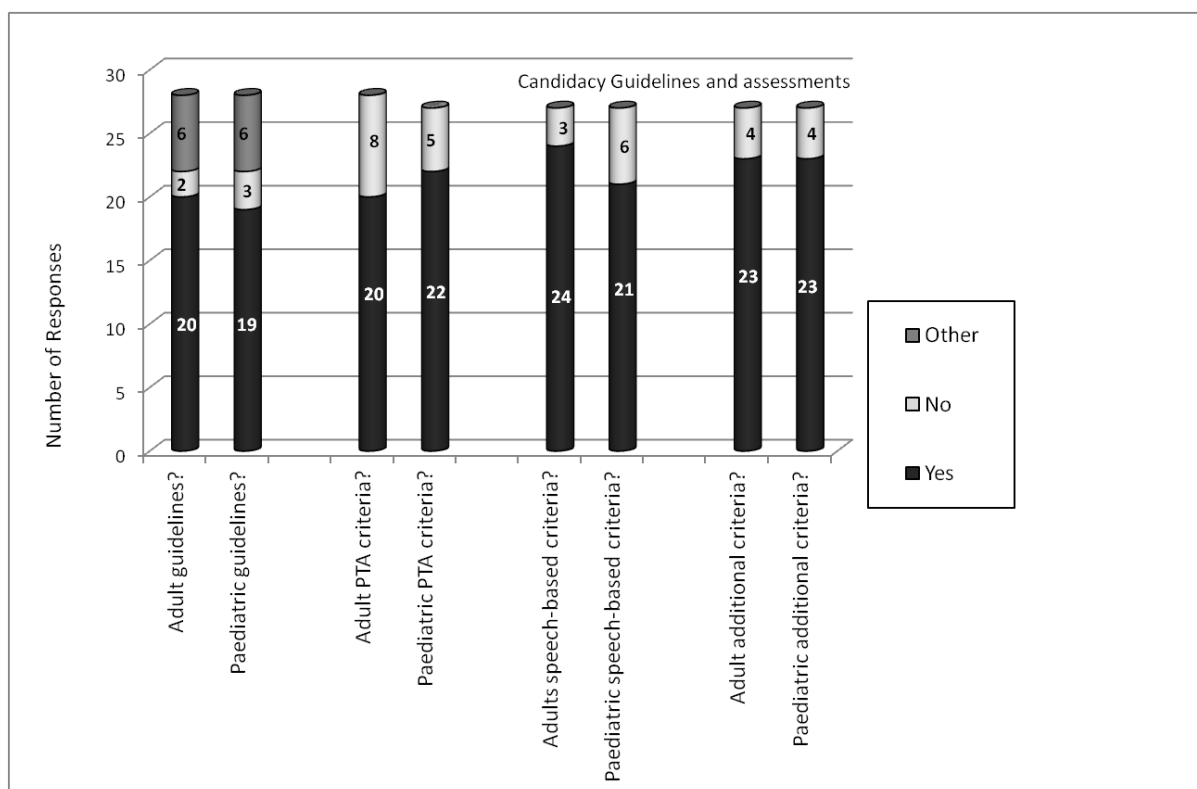
115 level or by private insurance, and in 10% of the countries implants are predominantly only
116 available through self-funding with some local funding support (India and Bosnia
117 Herzegovina).

118 The situation is rather different for adult bilateral CIs with only 22% of countries currently
119 offering bilateral CIs to adults with national or local funding. However private insurance does
120 cover the costs in 37% of countries, but for approximately 40% of the countries bilateral CIs
121 for adults are only available through a self-funding route.

122

123 ***Presence of obligatory guidelines or criteria***

124 Figure 2 shows the distribution of the use of guidelines and candidacy assessments and the
125 numerical breakdown for each category. The findings show that around 70% of countries
126 have National or Local guidelines in place that govern candidacy for implantation, 10% do
127 not have guidelines in place that they have to comply to, and 20% have guidelines but the
128 decision about whether an individual is a candidate for implantation is down to the individual
129 clinical team.



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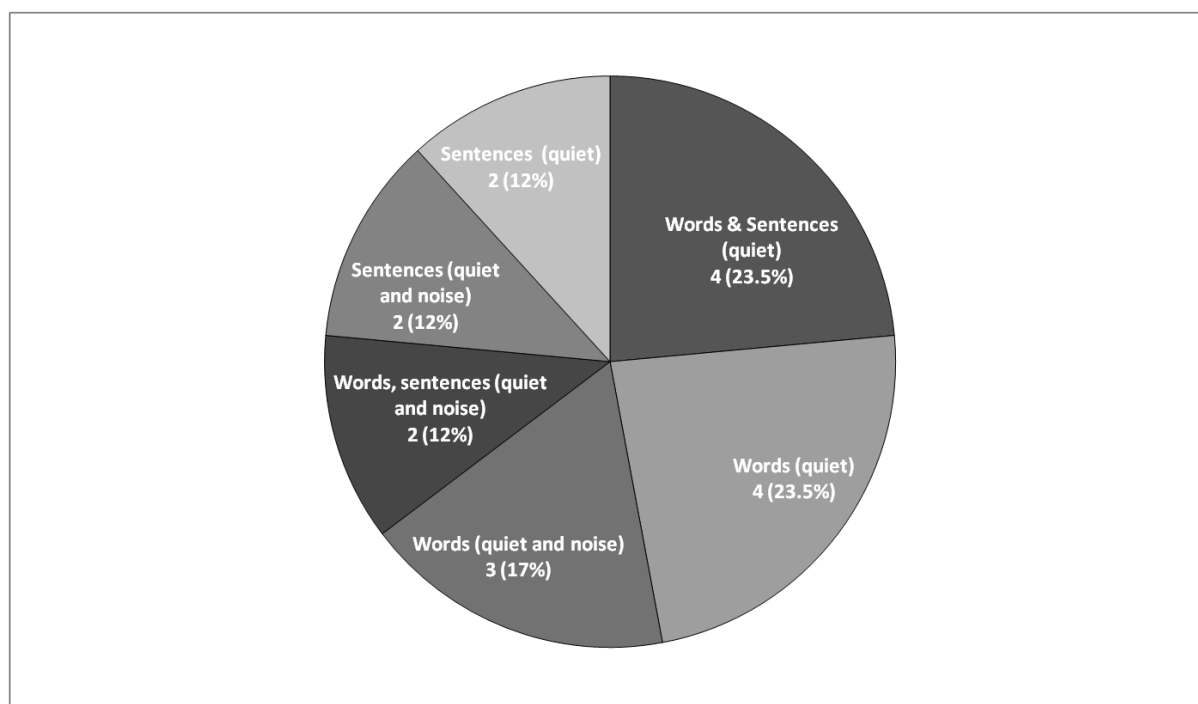
131 Fig 2. As for figure 1 but for the use of candidacy guidelines and assessments

132 Approximately 80% of countries have audiometric criteria in place for paediatric
 133 implantation, but only 70% of the respondents had audiometric guidelines for adult
 134 implantation. For the remaining clinics not using audiometric guidelines, the respondents
 135 reported that functional outcomes were a greater driving force for determining candidacy in
 136 their countries. For those reporting audiometric criteria, a range of candidacy rules were
 137 used; the responses ranged from the guidance in Australia which requires the average
 138 thresholds above 1500 Hz to be greater than 70 dB HL, to those in Belgium where the
 139 average thresholds should be greater than 85 dB HL at 500, 1000 and 2000 Hz bilaterally, or
 140 the UK guidance in which thresholds should be greater than 90 dB HL at both 2 and 4 kHz
 141 bilaterally. The most accepted pattern of audiometric candidacy used criteria in which the
 142 average thresholds should be greater than 75-80 dB HL at frequencies above 1 kHz for an
 143 individual to be considered a candidate. Eighty-five percent of countries have speech-based

144 criteria for adults and approximately 60% have speech-based paediatric criteria, with
145 assessments varying greatly dependent upon the developmental age of the child.

146

147 Figure 3 shows the categories of speech tests that are used for candidacy assessments in
148 adults, based on 16 respondents.



149

150 Fig. 3. A pie chart showing the types of speech perception tests used for candidacy
151 assessment in adults in different countries. The total of respondents was 17. Each shaded
152 segment relates to a different measure as labelled.

153

154 Twenty four percent of countries use purely sentence test based measures and approximately
155 40% use word test measures, the remaining 36% use combined sentence and word test
156 criteria.

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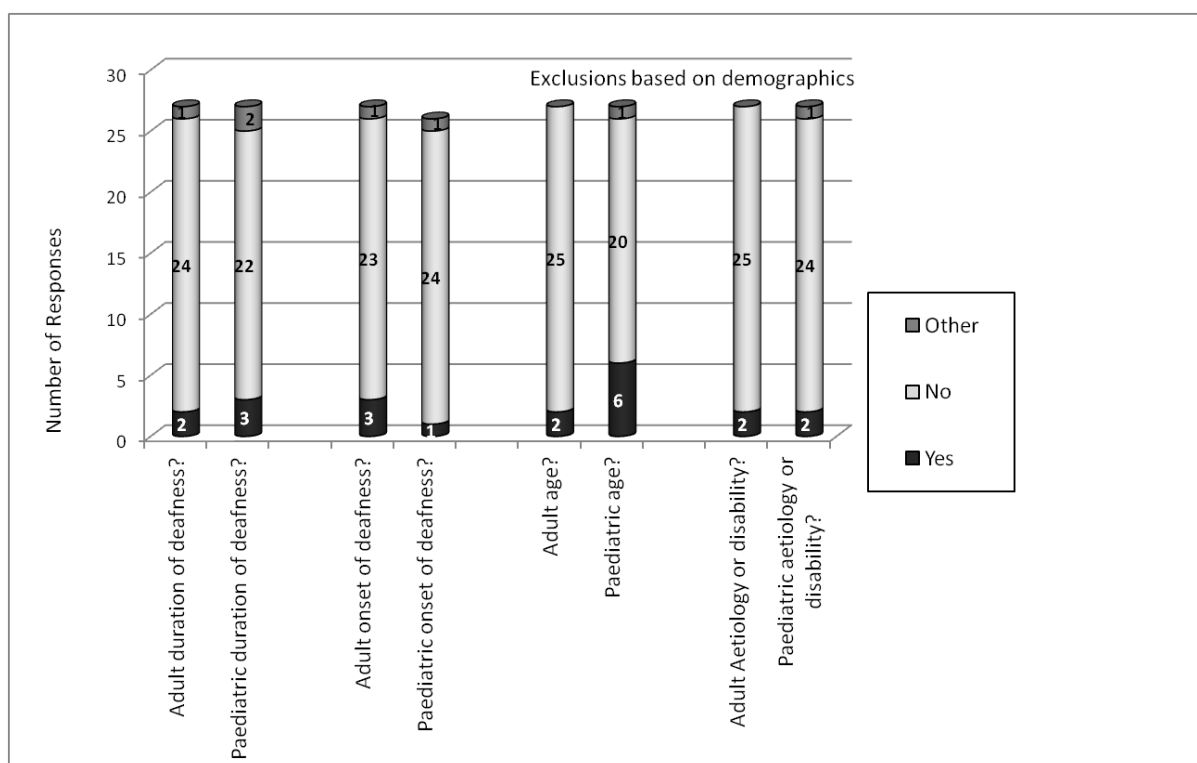
158 Over 80% of countries use additional assessments such as medical evaluation (i.e. scans
159 indicating that the individual is appropriate for implantation and that they are sufficiently

160 healthy to undergo surgery), mental health assessments to determine if individuals have
 161 appropriate expectations and are prepared for the process of implantation, effective previous
 162 hearing aid use and current lack of benefit from appropriately fitted hearing aids for speech
 163 and language. In addition, 43% of centres reported utilising questionnaire results to
 164 determine the impact of the hearing impairment and to determine the individual’s functional
 165 use of hearing.

166

167 ***Specific exclusion factors***

168 Only 10-20% of countries have specific exclusion factors within their candidacy assessments
 169 based on age, duration of deafness or aetiology. Paediatric age was the largest area for
 170 potential exclusion from implantation (see figure 4).



171

172 Fig. 4. As for figure 1 but based on exclusion categories

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174 ***Flexibility allowing someone falling outside criteria to be offered an implant.***

175 In Germany, Italy and Australia the teams have a great deal of flexibility and the clinical
176 team determine if an individual is an appropriate candidate. The same is true for the clinics
177 with a predominantly self-funding model. Some of the other countries, for example the UK,
178 have occasional success on a case-by-case basis for obtaining funding for special cases
179 outside criteria.

180 For subjects falling outside criteria the candidacy areas which are most effective at being
181 funded are Auditory Neuropathy Spectrum Disorder (ANSD), in which the audiogram is
182 often waived as a candidacy measure; Electro-Acoustic Stimulation (EAS, which has US
183 Food and Drug Administration approval) and Single-Sided or asymmetric Deafness (SSD).
184 For countries offering CIs to SSD cases it is typical to undergo a CROS or Bone-Anchored
185 hearing aid trial, and one clinic was only able to implant if the individual suffered from
186 tinnitus. Three respondents reported that their clinics were moving away from threshold
187 requirements being bilaterally based and that as long as the ear to be implanted was within
188 criteria it was acceptable, this was for both adults and children in two of the centres and just
189 for adults in the third.

190

191 **Discussion**

192 The results of this study demonstrated that there are many common practices that are shared
193 internationally, as well as highlighting the differences in the access to implants and the
194 candidacy requirements in the different countries. Some countries do not work with the
195 luxury of National or Health insurance funding, and only have the option to provide implants
196 for individuals who can fund the implant themselves. These clinics often have greater
197 flexibility in choosing whom they can consider to be an implant candidate. The majority of
198 countries/clinics focus mainly on the functional outcomes and utilise questionnaires and a

199 range of speech-based outcome assessments to determine candidacy, while the tonal
200 audiogram itself is becoming less of a stringent requirement. For those countries/clinics that
201 do still have an audiogram-based assessment, the UK and Belgium operate with the strictest
202 audiometric cut offs, which are dramatically different from the 70 dB HL average thresholds
203 at frequencies greater than 1500 Hz used in Australia. The majority of clinics with
204 audiometric criteria use an average of 75-80 dB HL cut off for frequencies greater than 1
205 kHz, and this is in line with the recommendation that is being put forward in the UK to
206 amend audiometric guidelines to be 80 dB HL at 2 and 4 kHz.

207

208 There is a general move away from requiring the candidacy cut off to be met in both ears, and
209 in several countries cases with SSD are implanted. Individuals with residual hearing are
210 routinely being provided with EAS systems in most countries and individuals with ANSD are
211 commonly provided with implants. All of this suggests that these areas of candidacy are the
212 natural development that should be incorporated into all candidacy guidelines.

213 What is clear from all of the respondents is that decisions about implantation are based upon
214 the decision from a multi-disciplinary team, containing medical, surgical, audiological,
215 educational and rehabilitation professionals. There are many components used to determine
216 if an individual would be appropriate for implantation and the goal of all professionals in the
217 field is that they should provide the most appropriate intervention for optimising the hearing
218 abilities of each individual.

219 **Acknowledgements**

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