



Guidelines for the definition and management of 'optimally aided' for experienced adult hearing aid users with severe and profound deafness

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Aim and scope

The specific goal of these guidelines is to provide a set of statements, recommendations, and strategies for both the hearing healthcare professional and the patient to recognise when hearing aids are optimally aided and, therefore, cannot be improved further in the audiological management of adults with severe and profound deafness. This may also lead to further conversations about other rehabilitative management options for the patient (see sections 4 and 5) and faster referrals for cochlear implant assessment.

The guidelines are focused on adults with severe and profound deafness in the better ear. Conductive deafness is largely excluded. Precipitous and asymmetrical deafness, with at least a severe degree of deafness in the better ear, are included.

For the purposes of these guidelines, the British Society of Audiology's (2018 A) definitions will apply where severe deafness is an average deafness of 71-95 dB HL (across hearing threshold levels at 250, 500, 1000, 2000 and 4000 Hz). Profound deafness is an average deafness of >95dB HL.

This document relates to optimising amplification when listening to speech for people with severe and profound deafness. In this document, hearing aid settings are advised to achieve and maintain a level of speech audibility that supports aided speech recognition.

It is, however, important to consider that not all users of hearing aids have the goal of hearing speech. Deaf adults who use British Sign Language to communicate may have different listening goals. It is also important to use culturally competent practices to assist hearing aid clinics, although this is outside the scope of this document. (Hulme at al., 2021, 2023 & 2024).

This document is written specifically on the definition and management of 'optimally aided' for experienced adult hearing aid users with severe and profound deafness. For further advice on managing patients with severe and profound deafness, please refer to section 6 of this document for additional resources.

Introduction to severe and profound deafness

It is important to note that people with severe and profound deafness need additional support when compared to their better-hearing peers. They have additional complexities within the auditory system; adding gain will not eliminate their communication problems. Clinicians need to consider that the result of a hearing aid fitting is limited by the processing capability of the peripheral and central auditory system and that few patients with severe sensorineural deafness will achieve high levels of speech recognition in complex listening situations (Souza, 2020).

Individuals are often long-term, full-time users of hearing aids who, because of their degree of deafness, are highly reliant on their devices and have unique amplification needs. They require a wide range of input levels to be audible, comfortable, and safe within a narrow residual hearing range (Convery, 2011). They often experience inadequate speech audibility (Souza & Bishop, 1999) and are likely to experience poor frequency selectivity and distortion due to cochlear dead regions (Aazh & Moore, 2007). High-powered hearing aid technology has drastically improved over the last two decades; however, hearing aids may never be fully sufficient for people with severe cochlear damage (Lesica, 2018). Conversely, patients with severe conductive deafness often have very good speech discrimination and get very good results from amplification. See section 6 for further resources on severe and profound deafness.

Please note that evidence is limited in this patient group around what a good outcome, once aided, looks like, and advice is only provided where evidence is available.

Options for optimally aiding adults with severe and profound deafness

The following recommendations may be helpful when ensuring optimal aiding whilst recognising individual variability in hearing loss, auditory processing, and brain plasticity, which may impact outcomes.

1. To ensure adults are optimally aided, audiologists *should* consider:

- 1.1 Person-Centred Care: Hearing aid settings should be optimised to suit individual needs and goals (BSA, 2016), e.g., hearing aid fitting pathway, follow-up care arrangements and/or hearing aid style should all be adapted as needed to suit the patient's need. It is important to work directly with the patient on their overall listening needs (which may not be directly related to optimising speech perception).
- **1.2 Binaural aiding**: can be considered for all adults with bilateral deafness, irrespective of the level of deafness, duration of deafness and previous experience with amplification; two hearing aids should be offered [even if this has been unsuccessful in the past]. (NICE, 2018; Turton et al., 2020). Binaural aiding increases the opportunity for binaural listening advantages; it also stimulates both ears/auditory nerves, which limits/prevents auditory deprivation, meaning a Cochlear Implant can be considered in either ear (now or in the future). Some adults may experience binaural interference (Gallun, 2021), and there may be complications from distortion and dead regions (Cox et al. 2011), so careful validation and evaluation are required (see section 3).
- **1.3 In-situ Real Ear Measures (REMs)** Should be used to confirm the electroacoustic properties of the hearing aid and earmould in the ear, i.e., frequency response, output, and compression (BSA, 2018). See section 3.3. Verification should include:
- **1.3.1** A validated prescriptive procedure should guide frequency-gain settings; for example, NAL/DSL can be used as a starting point when prescribing output.
- **1.3.2** Previously used settings/prescriptions are important to consider; patient preference and bestoutcome settings will vary for each adult. For example, long-term amplification users may prefer significantly more gain than the prescription recommends.
- **1.3.3** Adults transitioning from paediatric services should be allowed to remain on their chosen prescription (likely to be DSL-paediatric).
- **1.3.4** For adults with an air-bone gap, bone conduction thresholds should be incorporated into the prescription.
- **1.3.5** When REAR is not possible, a measured RECD and coupler fitting can be used and is equally as accurate as REAR with small vents or closed ear moulds.
- 1.4 Amplitude compression ratios and compression speeds: Fast-acting compression distorts the speech envelope. To limit this distortion, lower compression ratios are recommended [≤ 1.5] (Windle et al., 2023). Slow-acting compression does not distort the speech envelope significantly, so compression ratios of ≤ 3.0 can be used (Dillon, 2012). There may be times when patients have extremely narrow

dynamic ranges that are unavoidable; alternative options are to increase gain for soft sounds (G50) or decrease gain for loud sounds (G80).

Speak to your manufacturer, as these are often labelled in the software under manufacturer-specific names, so you understand what is being provided through the software and the model of the hearing aid being fitted.

- 1.5 Directionality: Directionality improves the signal-to-noise ratio without causing distortion so that it can be employed for all individuals. It offers benefits when the signal and noise are separated or moving (i.e., in constantly changing listening situations where the speaker and noise are moving/changing). Automatic/adaptive directionality should be used rather than fixed directionality as default, although the individual may like more directional programs to be available (Turton et al. 2020).
- **1.6 Volume controls:** Should be offered, especially to experienced users of VCs (consider a remote control or suitable app interface if dexterity problems). Separate volume controls for each ear/aid can allow for the sound/signal on one side of the listener to be increased without increasing the volume of all sounds around the listener, and this may improve the signal-to-noise ratio/listening in noise [but settings should always be based on patient-preference] (Turton et al. 2020).
- **1.7 Earmoulds**: Comfortable, deep, and well-fitted moulds using appropriate materials should be provided that form an acoustic seal, preventing feedback (feedback managers do not limit gain or are not required) and minimising the occlusion effect.
- **1.8 Telecoil loop and wireless connectivity** (directly or via streamer) are discussed and offered, e.g., for music, phone calls, conversation in background noise, or listening over a distance.
- **1.9 Remote microphones:** Adults with severe and profound deafness can benefit from remote microphone systems in various situations and should be fully informed about them (NICE, 2019; Turton et al., 2020).

2. To ensure adults are optimally aided, audiologists *may wish* to consider:

Additional hearing aid features that could provide benefits:

2.1 Frequency-lowering (FL): Selected, verified, and validated to ensure; a) aided audibility is improved [important note: adults with profound losses may never have audibility restored with FL enabled]., b) speech quality is not impaired, and c) the patient reports good outcomes/benefit with FL after a real-world trial. High frequency focussed speech tests (such as the Phoneme Perception Test by Phonak) can be sensitive to the effects of FL but are not reflective of real-world listening. No gold standard exists for the validation of FL. Settings should be as conservative as possible to maximise audibility but minimise distortion. For further guidance on verification of FL, see BSA, 2018. For a useful systematic review of the benefits of FL, see Simpson et al. 2018 and Akinseye et al. 2018. For detailed advice on FL selection and verification (including the use of Maximum Audible Output Frequency/MAOF), see the 'Frequency Lowering Fitting Assistant', available at: https://web.ics.purdue.edu/~alexan14/fittingassistants.html

- **2.2 A music programme:** Selected and adjusted based on patient preference and musical listening needs. For advice and resources on hearing aids for music (for professionals and patients), see '*Hearing aids for music*' website: <u>https://musicandhearingaids.org/resources/</u> (Hearing Aids for Music, 2017).
- **2.3 Digital noise reduction:** Select any noise reduction technology within the hearing aid software. Individuals with severe and profound deafness still experienced advantages from this technology in both listening effort measures and subjective sound quality assessments without adversely affecting speech intelligibility. (Dong et al. 2024).
- **2.4 Other technologies**: Provide information on accessing a range of technologies that can connect the patient with the hearing community (e.g., speech-to-text apps/speech-to-sign language technology), technology for emergency situations and alerting the patient to different situations (e.g., doorbells), technology for perceiving music, and technology for environmental sound awareness and localisation. (Hermawati et al. 2019).

3. Fundamental considerations

- **3.1** Maximising audibility and minimising distortion: Individuals with severe-to-profound deafness do not have access to the temporal fine structure of a speech signal and are more dependent on the overall speech envelope for understanding (Jorgensen et al., 2018; Moore, 2021; Souza, 2009). Many advanced hearing aid features are focused on exaggerating temporal fine structure and, therefore, inappropriate. Features that cause significant distortion include fast-acting compression and high compression ratios, noise reduction, and frequency-lowering. As a rule, the clinician should seek to introduce minimal distortion to the speech signal whilst aiming to maximise speech recognition. The clinician should attempt to maximise the Speech Intelligibility Index (SII) of the hearing aid using probe tube measurement (see section 3.3 and section 9 of the BSA 'Guidance on the verification of hearing devices using probe microphone measurements') to see if it falls within the expected range associated with the deafness.
- **3.2 Self-report preference:** Experienced amplification users can reliably self-report on hearing aid sound quality, comfort, and benefit within a clinical setting. Patient opinion and feedback should be used to fine-tune hearing aids during the fitting/exchange, and patients should feel happy with the sound quality and settings of their hearing aids before they leave the clinic.
- **3.3 Verification**: It is important to recognise that although Real Ear Measurements (REM) are the recommended approach and provide objective setting guides, there are potential errors in the REM process (e.g., probe tube placement/wax blocking the probe) and the clinician should assess all gain settings. For example, a "sense-check" would ensure that gain/output is broadly equal in both ears where an individual has symmetrical deafness, that gain/output is neither excessive nor minimal in relation to hearing thresholds, or that the hearing aid gain/output does not have an unusual shape.
- **3.4 Validation and evaluation:** It is important that subjective and functional outcomes are assessed after a period of acclimatisation, which may range from 6 weeks to 3 months. Please note that there are

currently no validated outcome measures for this specific patient group. The results from outcome measures and speech tests may indicate a need for further optimisation and fine-tuning. Subjective outcome measures include validated **self-report questionnaires** (relating to hearing, tinnitus, or quality of life), e.g., Client Orientated Scale of Improvement (COSI), Glasgow Hearing Aid Benefit Profile (GHABP), International Outcomes Inventory for Hearing Aids (IOHA), Hearing Handicap Inventory (HHI). **Aided speech testing in quiet**, including live voice or recorded speech tests, using phonemes, words, or sentences, e.g., CVC test, AB words, BKB sentences, IHR sentences, and CUNY sentences. See BSA (2019). The results from speech testing are particularly helpful in providing information for counselling patients around expectations when aided 'optimally'. Clinicians should consider that subjective feedback/self-report of real-life situations supersedes functional speech test results; essentially, the patient is an expert on their own hearing loss and will provide further insight on which functional tests performed in the clinic may not.

- **3.5** Adults with low vision or blindness require minimal disruption/distortion of acoustic cues to support localisation. Consider offering a fully omnidirectional setting/programme and further reducing compression speed and compression ratios or using a fully linear setting, particularly in the low frequencies due to interaural time differences [whilst considering loudness tolerance/listening comfort] (Simon and Levitt, 2007). Ideally, there should be provision for spare sets of hearing aids for this patient group so that they avoid periods without auditory input due to device malfunction or loss.
- **3.6 Cochlear dead regions:** Adults who report distortion/poor sound quality with amplification and have poor outcomes with hearing aids (despite optimisation) may have cochlear dead regions. For adults with extensive dead regions, the benefit from amplification may increase if gain/output is decreased at the 1.7 x edge frequency of the cochlear dead region. (See Figure 6, page 28 in Pepler et al. 2016 for a useful clinical decision-making flow chart with adults with dead regions). A TEN test can be useful to estimate the size and place of dead regions [although this is only accurate to the nearest octave, and the test cannot be used once thresholds exceed 90 dB HL] (Moore, 2001; Bird, 2010; Pepler et al. 2016).
- **3.7 Expectations:** Does the person have realistic expectations about what amplification can deliver for their level of hearing? Would the patient benefit from more specialist support from either a team specialising in severe and profound deafness or hearing therapy? When customised counselling is provided for patients' social and emotional well-being, these two areas improve distinctly (Yadav, 2023). Ensure this is explored and addressed at (re)assessment before proceeding with hearing aid fitting when goals and management plan are agreed e.g., Motivation tools by the IDA Institute: https://idainstitute.com/tools/motivation_tools/.
- **3.8** Additional rehabilitation: Technology plays an important role in treatment options for severe and profound hearing loss. How well a client responds to any audiological intervention depends in part on how well they can adjust to their everyday communication challenges and how they manage their personal relationships. Equally, all clients with severe and profound hearing loss will need to supplement their amplified hearing with speech reading and other communication strategies. Would the patient benefit from auditory training / lipreading classes, group rehabilitation or peer support volunteers? (Löfvenberg et al. 2022).

- **3.9 Hearing aid use:** All barriers to consistent hearing aid use should be explored; can the user consistently use the hearing aid(s) confidently? Have the data logging for hearing aid use? Does this provide any further counselling information? Is the patient aware of the acclimatisation period for adjusting to new hearing aids or other technology provided? Has there been a manufacturer change in their device, which may mean further adaptation time and acclimatisation are required? Should they be provided with incremental changes to the amplification to help with adaptation? It may be beneficial for regular follow-ups to offer further advice, practice, and/or support, which may need to be planned.
- **3.10** Environmental sounds: In addition to their hearing aids, the patient should be signposted to places that provide assistive equipment, such as doorbells, smoke alarms, amplified phones, and support with text relay. These may be through social care services or private providers, depending on the local setup and patient requirements.

4. Cochlear Implant referral

Evidence shows that for the appropriate candidates, there are large, life-changing benefits postimplantation, the magnitude of which cannot be achieved using hearing aid technology alone. Educating and counselling our patients regarding the continuum of available hearing technologies equips them with the knowledge that hearing aids need not be the final stop on their hearing journey (Turton et al., 2020).

- **4.1** Adults whose hearing thresholds meet the NICE criteria may be eligible for referral for a CI assessment i.e., **thresholds of 80dB HL or greater in <u>both ears</u> at <u>any 2 frequencies</u> [0.5, 1, 2, 3, 4 kHz]** (NICE, 2019). Please note that this includes reverse slope, cookie-bite, and ski slope losses. Aided speech perception testing can be useful to check the benefits of hearing aids and confirm eligibility for referral in these adults. Please contact your local cochlear implant service for advice and support on making appropriate referrals. You can identify your local centre at the British Cochlear Implant Group website: <u>www.bcig.org.uk</u> . Cochlear implant referral resources are also available via the British Academy of Audiology: <u>www.baaudiology.org/professional-information/cochlear-implant-champions/ci-champions-resources/</u>
- **4.1.1** Adults who do not meet the NICE audiometric criteria but do show poor benefit from hearing aids (and score poorly on speech tests) may have Cochlear Dead Regions and should still be considered for CI referral. TEN testing prior to referral is useful but not essential (Bird, 2010).
- **4.2** For adults to be considered for CI, they need to have trialled hearing aids with optimised speech settings (as defined in this document). If patient preference is for different settings (e.g., well under or over a validated prescription target), consider offering an additional programme with 'optimised settings/set to target' so they can trial the 'optimised settings' in real-world listening situations and try to adapt to the new sound slowly over time (without losing their preferred settings). Discuss this on a case-by-case basis with your local CI team to ensure that adults are referred at the earliest opportunity (to increase their opportunity for positive outcomes with CI).
- **4.3** For advice on CI candidacy, counselling and referral, see the BAA/BCIG CI champions webpage: <u>https://www.baaudiology.org/professional-information/cochlear-implant-champions/</u>

- 4.4 Patients may benefit from looking at peer support resources from the National Cochlear Implant Users Association (NCIUA) <u>https://www.nciua.org.uk/</u> and the National Association of Deafened People (NADP) <u>https://www.nadp.org.uk/</u> or if the patient has dual sensory loss Sense <u>https://www.sense.org.uk/</u> or Deaf Blind UK <u>https://deafblind.org.uk/</u>
- **4.5** Record keeping is important for patients where discussion of CI referral has been undertaken to help with continuity of care and to note any deviation in hearing aids prescription settings so that this can be shared with CI centres in the referral. Patient management systems can support ongoing monitoring and clinical audit for this group. See the CI champions section of the BAA website for more information.

5. Take home messages

- **5.1** Hearing aids form only part of aural rehabilitation for adults with severe and profound deafness. It is vital that adults are given all the support possible to maximise their ability to manage their deafness. This may include help and adjustment with severe and profound deafness, alongside signposting/referral for: Implantable devices, Assistive Listening Devices, lip-reading classes, Access to Work, communication training for family/friends/carers, peer support, self-management strategies, self-help groups, Hearing dogs, Deaf-awareness training, and tailored support in the workplace.
- **5.2** Cochlear implants should always be considered as a treatment option for adults with severe-toprofound deafness. However, it is important to ensure adults are optimally aided to get the best possible outcomes with their hearing aids. Every patient who falls within criteria should have this option discussed with them. However, respecting if someone does not want a cochlear implant is also important. When this is the case, the Audiologist should focus on supporting the person with the significant deafness they have. Cochlear implants should continue to be reviewed as an option even if they have previously declined, but this conversation needs to be managed in a culturally sensitive way. Evidence shows that adults in the UK are not routinely offered a cochlear implant assessment when they are near or at the NICE criteria. (Cullington et al. 2024). CI referral depends on where the adults live and how old they are (older adults are significantly less likely to be considered for CI referral by Audiologists). This postcode lottery needs to be reduced.
- **5.3 Optimisation is an ongoing process.** We must continually support these patients with ongoing maintenance, reassessments, and self-management strategies.





Hearing Aid Optimisation Checklist

A. For the patient to be optimally aided, you should:

- 1. Have you maximised speech recognition audibility and minimised speech signal distortion by maximising the SII using probe tube measurements? □
- 2. Do you understand the patient's goals and individual needs around their deafness? \Box
- 3. If there is bilateral deafness, are they binaurally aided (where appropriate)? \Box
- 4. Have you undertaken in-situ Real Ear Measures to a validated prescription (including BC values where there is any air-bone-gap)? □
- 5. Are the hearing aid's compression ratios under 3:1? \square
- 6. Have you offered or activated any directionality on the hearing aid? \Box
- 7. Have you offered or activated any volume control on the hearing aid/app? \Box
- 8. Is their custom earmould comfortable, deep, and well-fitted moulds using appropriate materials?
- 9. Is the hearing aid free from feedback? \Box
- 10. Have you offered or activated any telecoil and/or wireless connectivity? \square
- 11. Have you offered or activated any remote microphones? \Box
- 12. Have you considered with the patient their self-reported preferences
 and balanced these with verification (REMs / RECDs)
 , validation (self-reported questionnaires and aided speech in quiet measurements)?
- 13. Have you counselled on realistic expectations about what amplification can deliver for their level of hearing?
- 14. Could the patient be referred to a specialist severe and profound team or hearing therapist for any further support on expectations?
- 15. Have you provided them with information for ongoing self-management, and do they understand when they should return for a reassessment of their hearing to ensure optimisation is an ongoing process?
- 16. Have you given the patient a copy of the BAA/BCIG Frequently Asked Questions Sheet? (Found at https://www.baaudiology.org/app/uploads/2023/08/BAABCIG_Factsheet_Champions.pdf

B. You may also wish to:

- 1. Select and verify frequency lowering. \square
- 2. Offer a music programme depending on the patient's goals. \Box
- 3. Select and activate noise reduction technology depending on the patient's goals. \Box
- 4. Have you discussed and provided relevant information on other technologies which may help the patient connect with people with deafness / the Deaf community, for alerting devices, for emergency situations, for perceiving music and for environmental sound awareness?
- 5. Have you counselled on the social and emotional wellbeing of the patient linking back to their goals? □
- 6. Have you offered and provided information on any additional rehabilitation be provided through auditory training / lipreading classes, group rehabilitation or peer support volunteers?
- 7. Have you signposted them to social care for support with environmental sounds (doorbell/smoke alarm/information on Relay UK, etc.) or provided them with information on where assistive equipment can be purchased?

- C. If the patient is at/near the NICE criteria for cochlear implant assessment, you should:
- 1. Have you optimised the hearing aid (see section A 1-14)? \square
- 2. Have you discussed (or reviewed with the patient if previously discussed) the option of a cochlear implant assessment?
- 3. Have you provided them with written literature to consider this with their family and friends? \Box

6. Resources to support this document

- For detailed advice and guidance on this topic, see 'Guidelines for Best Practice in the Audiological Management of Adults with Severe and Profound Deafness' by Turton et al. (2020). <u>Thieme E-</u> Journals - Seminars in Hearing / Abstract (thieme-connect.com)
- For access to the BAA / BCIG Cochlear Implant Scheme <u>Cochlear Implant Champions British</u> <u>Academy of Audiology | British Academy of Audiology (baaudiology.org)</u>
- Resources for conversations as a Cochlear Implant Champion <u>CI Champions Resources British</u> <u>Academy of Audiology | British Academy of Audiology (baaudiology.org)</u>
- Access to the BCIG website on all things cochlear implant <u>British Cochlear Implant Group</u> (bcig.org.uk)
- For a range of professional resources and patient leaflets to support adults with severe and profound deafness, see the BSA Sound Practice website: <u>https://www.soundpractice.org.uk/</u>
- For research and evidence in each area, see: *American Speech Language Hearing Association*: https://www.asha.org/practice-portal/professional-issues/hearing-aids-for-adults/
- Henshaw et al. (2021) The use of hearing aids by adults with deafness: How should we define and measure success? NIHR. Nottingham Biomedical Research Centre. Poster presented at BAA Conference, Manchester. Abstract available here: https://www.baaudiology.org/app/uploads/2021/11/BAA-2021-abstract-book-in-full.pdf

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8. Declaration of interests

None to declare.