ADVANCED BIONICS
POWERFUL CONNECTIONS

CLINICAL RESEARCH

The Advanced Bionics Bimodal Solution: Combining the Best of Both Worlds

Global Survey of Healthcare Professionals

THE ADVANCED BIONICS BIMODAL SYSTEM

Integrated Bimodal Hearing

To optimally support cochlear implant (CI) recipients with aidable residual hearing in the contralateral ear, Advanced Bionics (AB) and Phonak introduced the Naída Link line of hearing aids (HAs), designed to work in unison with CIs, in 2016. Since then, AB has continued to provide the most advanced bimodal solution. The Naída Link HAs not only match the AB CI sound processors in design but also align real-time with the CI's sound processing when a new sound environment is detected.

ADAPTIVE PHONAK DIGITAL BIMODAL FITTING FORMULA

To optimally complement hearing with the CI while minimizing HA fitting time, the Adaptive Phonak Digital Bimodal (APDB)[1] fitting formula was developed. The APDB fitting formula optimizes hearing for AB bimodal listeners by adjusting the frequency response of the acoustic-hearing ear to match the CI, aligning the loudness growth between the CI processor and the HA, and synchronizing the dynamic behavior between the two devices, resulting in improved sound quality[2] and speech intelligibility.[3] Besides providing benefits to bimodal CI recipients, the APDB fitting formula also benefits professionals fitting HAs to bimodal listeners by making the fitting process easy and straight-forward.[4]

EAR-TO-EAR TECHNOLOGY

The ability to wirelessly share audio signals with each other in real-time, referred to as Binaural VoiceStream Technology (BVST)[5] or ear-to-ear streaming is unique to AB and Sonova hearing solutions. This technology enables access to the only third-order beamformer for improving speech understanding in very noisy situations for listeners with two compatible AB and/or Phonak devices (StereoZoom). Examples of other unique BVST based features include ZoomControl (focuses on a speaker located at the back, left or right), DuoPhone (streams phone calls to both devices simultaneously for stereo hearing), and QuickSync (simultaneous adjustments to volume and program settings on both devices). BVST also makes it possible to stream media bilaterally or bimodally. While these features were initially developed by Phonak for HA users, studies have consistently shown benefits for CI users. Using StereoZoom for example, significant improvements in speech intelligibility in noisy environments were shown for bimodal and bilateral CI users[6] and ZoomControl lead to significant speech intelligibility improvements when listening to a speaker from one side.[2]

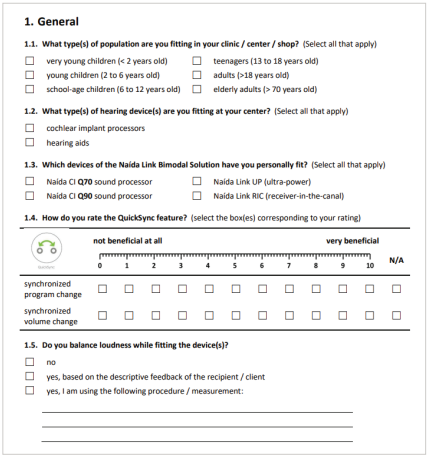
SOUND CLEANING

Sound cleaning features originally developed for HA users by Phonak such as WindBlock and SoundRelax as well as the second-order adaptive beamformer UltraZoom are also available on both the CI processor and the Link HA, and provide speech intelligibility benefits to CI users, for example when listening to a talker in a noisy environment.[7]

GLOBAL SURVEY

Gathering feedback from around the world

A survey was launched globally in 2017 to gather feedback about the AB bimodal system from healthcare professionals familiar with fitting one or both of the system's device types (CI and/or HA).



1. General

1.1. What type(s) of population are you fitting in your clinic / center / shop? (Select all that apply)

- ☐ very young children (< 2 years old)
- ☐ young children (2 to 6 years old)
- ☐ school-age children (6 to 12 years old)
- ☐ teenagers (13 to 18 years old)
- ☐ adults (>18 years old)
- ☐ elderly adults (> 70 years old)

1.2. What type(s) of hearing device(s) are you fitting at your center? (Select all that apply)

- ☐ cochlear implant processors
- ☐ hearing aids

1.3. Which devices of the Naida Link Bimodal Solution have you personally fit? (Select all that apply)

- ☐ Naida CI **Q70** sound processor
- ☐ Naida CI **Q90** sound processor
- ☐ Naida Link UP (ultra-power)
- ☐ Naida Link RIC (receiver-in-the-canal)

1.4. How do you rate the QuickSync feature? (select the box(es) corresponding to your rating)

	not beneficial at all 0 1 2 3 4 5 6 7 8 9 10 very beneficial	N/A
synchronized program change	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	☐
synchronized volume change	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	☐

1.5. Do you balance loudness while fitting the device(s)?

- ☐ no
- ☐ yes, based on the descriptive feedback of the recipient / client
- ☐ yes, I am using the following procedure / measurement:

SURVEY RESULTS

Improvements for professionals and patients

Data on respondents' geographical location (country), and fitting experience were collected. Ratings of several aspects of the bimodal system and the fitting process were obtained on an absolute scale from zero [not beneficial at all] to ten [very beneficial]. Responding professionals had the option of indicating "I don't know" for items they were unable to rate. The number of respondents making use of this option for each item is indicated in the figures. Additional multiple-choice questions evaluated respondents' fitting practice with the AB bimodal system.

STUDY POPULATION

Replies from around the globe

Eighty-two responses from professionals were collected from the following countries: Australia, Chile, Colombia, Costa Rica, England, Finland, Germany, India, Ireland, Lebanon, Morocco, Netherlands, New Zealand, Peru, Singapore, Spain, and Sweden (see Fig. 1).

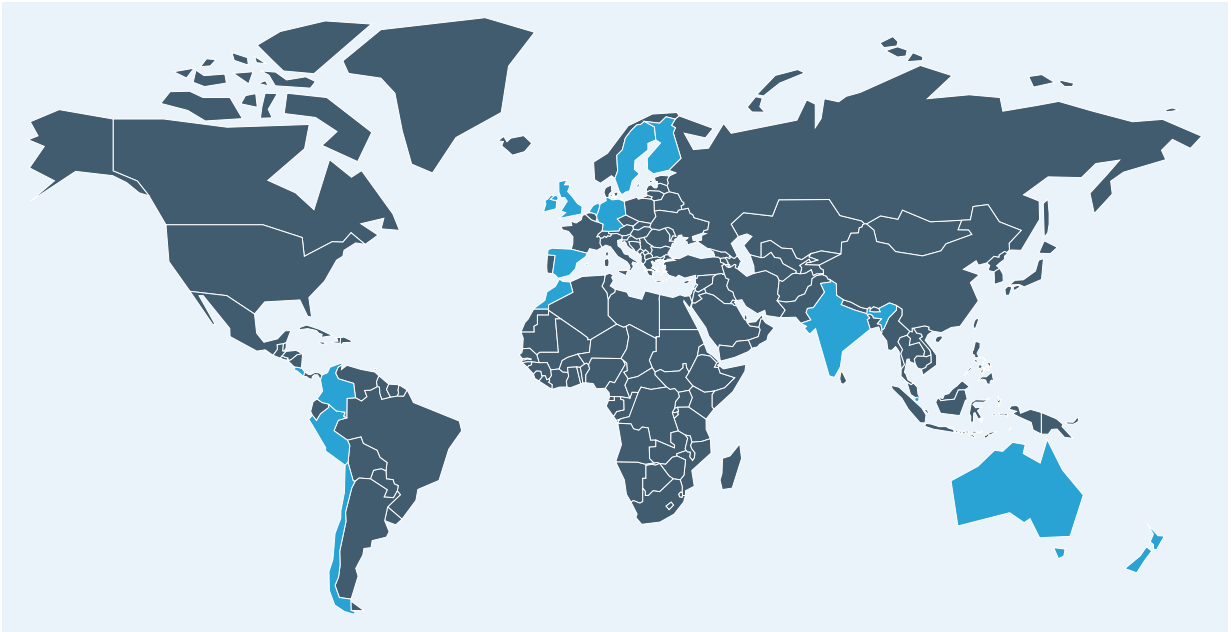


Fig. 1: Countries where responses were collected.

GENERAL FITTING EXPERIENCE

Experienced professionals provide feedback

Of the 82 respondents, 23 reported fitting CIs only (28.0%), four reported fitting HAs only (4.9%), and 55 reported fitting both CIs and HAs (67.1%). Most professionals also reported experience fitting all age groups of CI/HA recipients (see Fig. 2).

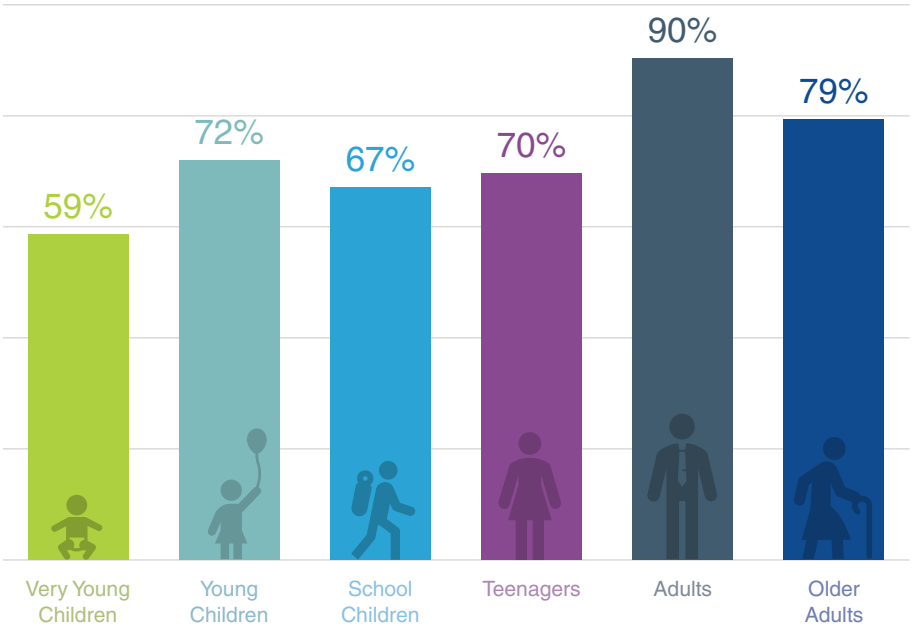


Fig. 2: Percentage of polled professionals fitting each patient age group (very young children: < 2 years; young children: 2 to 6 years; school-age children: 6 to 12 years; teenagers: 13 to 18 years; adults: >18 years; older adults: > 70 years).

ADAPTIVE PHONAK DIGITAL BIMODAL (APDB) FITTING FORMULA

The only dedicated Bimodal fitting formula

Professionals fitting HAs were polled on their use of the different available fitting formulae for different recipient age groups. While the dedicated pediatric fitting formula DSL pediatric was used for pediatric recipients by up to 20% of responding professionals, the dedicated bimodal fitting formula Adaptive Phonak, Digital Bimodal (APDB) was by far the preferred fitting formula for all age groups (Fig. 3).

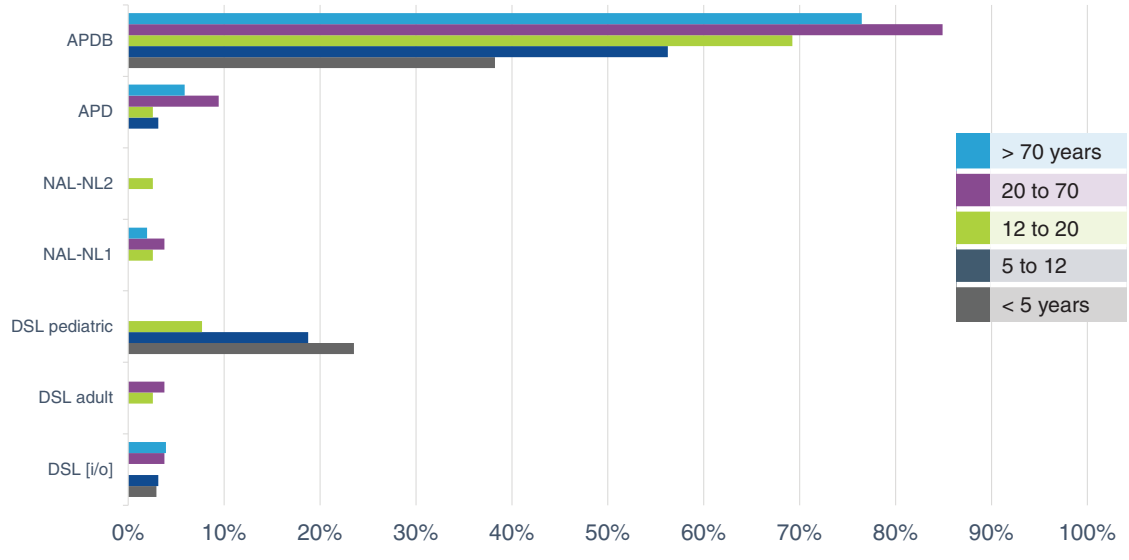


Fig. 3: Use of different fitting formulae for different recipient age groups. APDB: Adaptive Phonak Digital Bimodal; APD: Adaptive Phonak Digital.

When upgrading a bimodal recipient to the Naída Link bimodal solution using the APDB fitting formula, most respondents indicating only needing to perform global fine tuning to achieve an optimal fit for the recipient. If fine tuning is necessary, the most common parameters to be adjusted were the global gain (59%), followed by high frequency gain (36%), low frequency gain (34%), and noise management (32%).

SHARED AB AND PHONAK TECHNOLOGIES

Successful integration of features

The technologies, accessories, and design features shared across the CI and HA within the AB bimodal solution were consistently rated as very beneficial by 80% of professionals or more (Fig. 4).

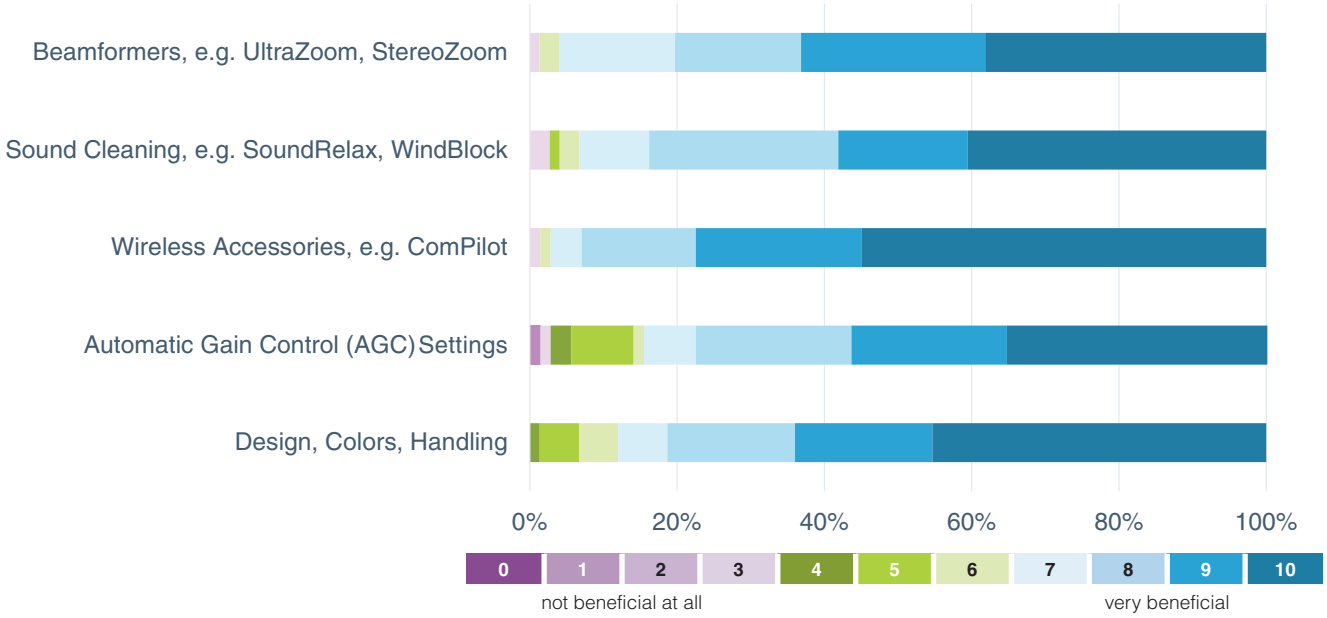


Fig. 4: Ratings of shared AB – Phonak technologies.

Professionals were asked to indicate how often they typically fit the AB – Phonak sound processing features for recipients of different age groups. While not commonly used for pediatric recipients up to the age of 12, directional microphones (beamformers) were fitted for most or all adult recipients by the majority of responding professionals. Similarly, sound cleaning features are more commonly fitted for adult recipients, with SoundRelax and WindBlock being more commonly used than EchoBlock. The former two are fitted to most or all recipients aged 20 years or older by around 80% of respondents.

*One-sample Wilcoxon signed rank test.

The QuickSync feature, allowing recipients to control volume and program settings on both devices with one touch, was rated as very beneficial for both control options (Fig. 5, ratings significantly higher than five out of ten).

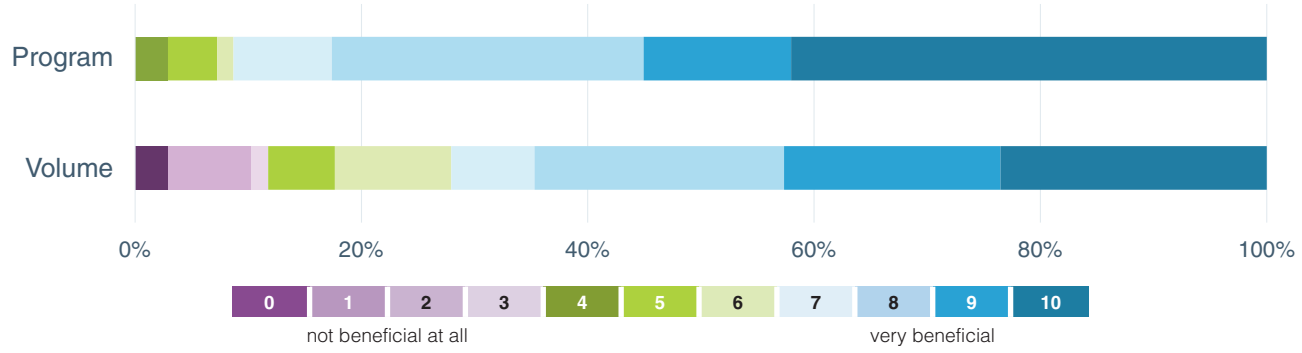


Fig. 5: Rating of the QuickSync feature for program (top) and volume (bottom) control.

THE BIMODAL SOLUTION

Meaningful improvements for professionals and recipients

Based on reports by bimodal recipients at their practice, professionals indicated the most commonly experienced benefits compared to the recipients' previous HA as better speech understanding in noise (63%), better sound quality (63%), and more balanced hearing across both ears (61%). Better sound localization, easier handling (program/volume change) and phone conversations were mentioned numerous times as well.

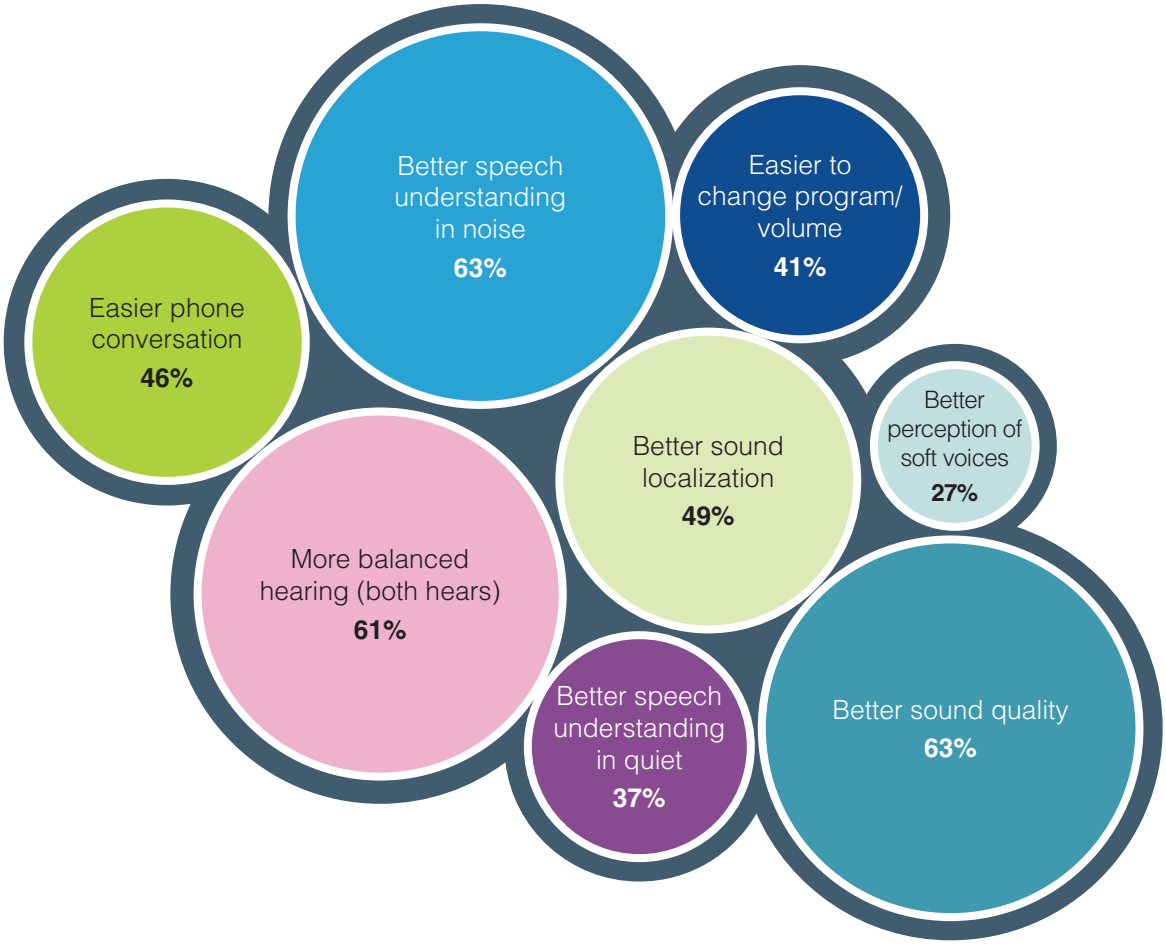


Fig.6: Subjective rating of different aspects of usability. All items were rated as significantly higher than 6 out of 10. N(IDK) indicates the number of respondents who chose the "I don't know" option for each item.

Professionals appreciated the simplicity of the AB bimodal solution and commended the shared technologies across both devices. Suggested improvements included the ability to fit both devices within one fitting platform.

> With Naída Link, bimodal fitting took a great step forwards.

> Fitting of CI and HA in one platform would be useful.

> Bimodal fitting seems to have been made as simple as possible.

> The Naída Link solution is currently the best option for bimodal patients.

> Naída Link gives a chance to share technology in one platform between the CI and hearing aid. This is happening for the first time in CI industry [...]. Shared technology helps the recipient [...] best. Great technology for giving true bimodal hearing.

> Simple and straightforward.

Fig.7: Open feedback collected from professionals.

SUMMARY

A significant innovation in Bimodal Hearing Solutions

The integrated bimodal system with its shared features and design was well received by CI professionals around the globe. The dedicated bimodal fitting formula (Adaptive Phonak Digital Bimodal, APDB) allows straight-forward fitting of bimodal recipients with little need for time-consuming fine-tuning and is the clearly preferred fitting formula for all ages of recipients. Based on professional reports, recipients benefit from better sound quality and speech understanding in noise as well as more balanced hearing across both ears. Eighty-eight percent of respondents would recommend the system to the majority or all of their potential recipients.

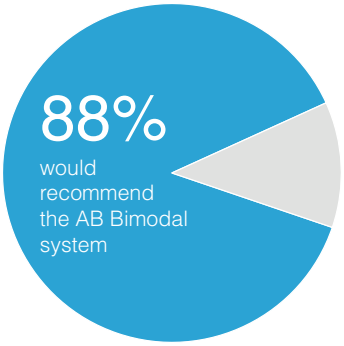


Fig. 8: Percentage of professionals recommending the AB bimodal system to all or the majority of CI candidates who benefit from a hearing aid on the non-implanted side.

OUTLOOK

Continued improvement answers professionals' feedback

The results of this survey represent professionals' opinions and experiences with the Naída Q series of sound processors and dedicated hearing aids, the industry-first integrated bimodal hearing system, introduced in 2017. The evaluated innovations and features represent the core technology of the AB bimodal hearing system, that remains the backbone of following iterations of devices.

Fig. 9: Naída Link M hearing aid and Naída CI M sound processor (left) and Sky Link M hearing aid and Sky CI M sound processor (right)

With the current generation of the AB bimodal hearing system, the technology was further refined, and improvements were made. The Naída CI M sound processor and Naída Link M hearing aid combine into the most advanced bimodal hearing system for adult users, while the Sky CI M sound processor and Sky Link M hearing aid represent the first bimodal solution specifically dedicated to pediatric recipients. All devices feature Bluetooth® connectivity, allowing users to seamlessly connect to any Bluetooth-enabled device. The machine learning based operating systems AutoSense OS 3.0 and AutoSense Sky OS 3.0 (the first dedicated pediatric operating system for CI) reduce the need to manually change programs and offer improved speech intelligibility.[8] The accompanying fitting software Target CI allows sound processors and hearing aids to be programmed within the same software platform, responding to professionals' feedback.

With these innovations, AB continues to provide the most advanced bimodal hearing system.

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