QS10 Subjective and objective evaluation of a personal radio aid system to determine its benefit must be carried out.

Evaluation is important in the fitting and use of radio aid systems for a number of reasons.

1. a radio aid system will not be effective unless it is used.
It is unlikely to be used
   - if it is not beneficial
   - if those involved have not received training

Thorough monitoring can assess what aspects, if any, are problematic, what needs to be tackled and how to avoid them in the future.

2. radio aid systems are costly and *should* be justified in terms of the advantages they confer.
The case for funding
   - on an individual basis
   - from the collated results from an entire local population
   - from national figures

   could be massively strengthened if systematic information that has been properly gathered and recorded is available.

3. comparison of outcomes with radio systems across services could highlight the need for
   - further training
   - more resources

   This would drive up standards to produce more equitable and effective provision across the country.

Evaluation is not a 'one off' activity; rather it is a process of gathering information to ascertain the extent to which the equipment is 'of value' to the user, given that needs may change over time e.g. as the child develops and as circumstances alter.

Ideally, a protocol should be in place whereby a baseline is established and regular evaluations occur, The frequency and flexibility of these reviews and the facility for a child to request an assessment in the case of a problem or a change of circumstances (beyond those anticipated by normal progression) reflect the good practice of a service.

A thorough evaluation will quantify the advantages that a radio aid provides in terms of

- improved performance on speech perception tasks
- the impact on the child and relevant adults or peers (who are using the system).
- the listening effort of the child

A rounded evaluation will help to assess the situation fully, and determine areas where extra support may be needed, or additional/different equipment beneficial. It will also highlight where human rather than technology assistance is required.

Evaluation – good practice

(i) Gathering information about and recording specific problems or barriers to the use of a personal radio aid, as well as subjective and objective measures, are important in order to obtain as complete a picture of benefit as possible.

The information from the evaluation can be collated and used to:

- highlight training needs of mainstream staff, other transmitter users and others
- inform Individual Education Plans e.g. target setting on use or management of the radio aid
- add to the child's developmental profile
- inform risk assessment
- inform individual support requirements e.g. for Special Educational Needs assessment/review

- inform provision of further equipment such as audio adaptors for interactive whiteboard/PC/language labs or directional transmitter/conference microphone for use in discussion groups
- refine use of the personal radio aid system e.g. selection of programme, use of different transmitter options etc.
- meet locally prescribed targets for audiological management.
- contribute to service quality assurance

(ii) Using questionnaires to evaluate a personal FM system fitting

A subjective observation schedule or questionnaire should be completed in addition to speech tests. For younger children, the questionnaires will be administered by the adults most closely involved with them. These questionnaires can be used regularly as ongoing evaluation tools. There is an acknowledged scarcity of published resources, but suitable tools include:

<u>For younger children</u>

- Early Listening Function (ELF) (Anderson, 2003)
- Children's Home Inventory for Listening Difficulties (CHILD) (Anderson and Smaldino, 2000)

(Both these have no published psychometric parameters, but used quite extensively for hearing aid evaluation)

- Parents Evaluation of Aural/oral performance in Children (PEACH) – (Ching, 2007)

<u>From 7 years approx</u>

- Listening Inventory For Education (LIFE) (Anderson and Smaldino, 1997) – Revised https://successforkidswithhearingloss.com/wp-content/uploads/2011/09/LIFE-R-Instruction-Manual.pdf

- Children's Outcomes Worksheet (COW) (Whitelaw, Williams et al, 2001) – no published psychometric parameters, but adapted from a well-validated adult hearing aid evaluation questionnaire i.e. Client-Orientated Scale of Improvement (COSI Dillon, James et al, 1997); used in Oticon study of FM systems in the classroom.
- Listening Situations Questionnaire (LSQ) (Grimshaw, 1998) – some psychometric properties researched during development, but unpublished.
- FM Listening Evaluation for Children (Gabbard, 2003) – no published psychometric parameters.

Once a child reaches an age when they can co-operate with such measures their own personal experiences (even room by room and teacher by teacher) should be recorded as they provide important insight into benefit and issues.

(iii) Observation of how the system is managed by the teacher and how (often, reliably, independently etc) it is used by the chid is also part of the wider evaluation.

(iv) The impact/benefit of use of a system can be 'measured' by using speech perception tests. There is still an element of subjectivity in scoring regimes but by and large speech perception tests offer some objectivity.

Over time professionals have developed their own procedures which differ from that set out in the original (2008) QS document part 2 Guidelines p. 37ff.

In a similar way the standardised speech tests have succumbed to small changes and they are no longer used for their design purpose or scored as intended. Whatever is used it is important that the design is well measured so that there are as few variables as possible if repeat testing is desirable and comparisons over time are anticipated.

It is helpful to know what signal to noise ratio is needed for the individual to reach an optimum score when coping in noisy class situations.
To prepare for a speech in noise test certain procedural pointers are helpful:

Recorded speech material
Live voice can be used 'in the field', and could also be used in a clinical situation. However, it requires meticulous delivery and measurement of input levels. Use of recorded speech materials more easily ensures the consistency of the level of presentation, and the ability to adjust the levels used.

Test room
Every effort should be made to keep ambient noise in the room to a minimum, and the noise level should be measured and noted with the test results.

Transmitter microphone placement in radio aid benefit evaluation
Usually a transmitter (Tx) is worn 15-20 cm from the speaker's mouth, **centrally** around the neck. If a clip on mic is used it should be placed centrally and not to one side. The transmitter needs to be placed in front of the loudspeaker in order to achieve an 80dBA input to the microphone.

Equipment
Good quality loudspeakers must be used and all signals must be calibrated accurately (Martin, 1997). If using a laptop connect an external loudspeaker.
Sound level meter – Class/Type 2 regularly calibrated; settings 'fast' and at a suitable Sound Level range.
Speech test material-according to stage and ability of child/young person
Suitable standardized noise signal (e.g. compressed speech babble).

There are complete kits available to perform speech in noise tests: each coming with specific test materials

SoundbyteSolutionsParrotPlus2

Ewing Foundation SIN;

Speech in Noise Evaluation Procedure

In this procedure the distances of loudspeaker positions are an initial guide when calibrating. The final position needs to be determined with a suitable sound level meter and will depend upon the acoustic properties of the room. So we are focused on sound level and signal to noise ratio rather than set distances. There is a SLM tolerance of 1-2 dB which should be applied to values throughout.

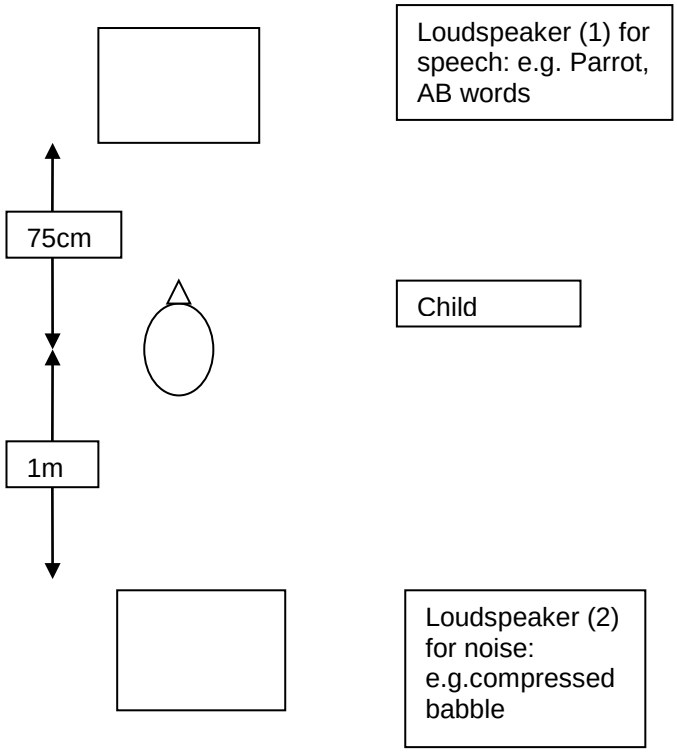
It is advisable to place the Roger radio aid transmitter into 'verification mode' for the procedure since the intermittent nature of the noise may affect the gain of the radio aid system. In 'verification' mode the gain is fixed.

1. Ensure that the hearing aids are set correctly and working, and that the radio aid system has been set up correctly (always do a listening check first).

2. Select an appropriate speech test, giving consideration to the user's developmental age and language skills (MCHAS, 2006). Explain the test procedure (repeating words, pointing to picture/toys etc.) to the child, with suitable examples. With a young child you may need to do a live voice test or a practice run.

3. Seat the child at a distance of 75cm from, and facing, the loudspeaker (1), 0˚ azimuth, which will deliver the speech signals. Place the loudspeaker for delivering the noise signal directly behind the child, 180˚ azimuth, at a distance of 1m. Both loudspeakers should be at ear level.

Diagram of test set up:



4. Select a suitable speech test in noise and complete an initial calibration check of both speakers. Adjust the speaker positions so that the SLM reads the calibration level (appropriate to the kit being used) at the child's ear.

5. Set the speech signal suitable for the child (initially try 60dBA); ensure child doesn't lean forward. Deliver and score the first list, with child using hearing instruments only. This should be noted as the **baseline score in quiet**. If child scores 100%, re-present the test at a lower intensity to avoid ceiling effect (aiming for 80-90%). **Write down the speech presentation level – for baseline in quiet (X)**

6. Using this baseline speech presentation level X introduce the noise at the same level at the child's ear. This will be a Signal to Noise Ratio (SNR) of 0dB. Deliver and score the next list. If the child is still scoring well, increase the noise in 5dB or 10dB steps until their performance has dropped to 50% or less, of their baseline score. (The needs of the individual might lead you to adjust the SNR ratio to ensure access e.g. +5dB SNR to continue.) This becomes **the noise level (Y)** for the next step with the radio aid**;** write it down.

7. Now establish the position of the transmitter such that it is giving an advantage when radio aid is in use. Place the transmitter in front of the speech loudspeaker appropriately by presenting the calibration signal and moving the position of the transmitter in front of the speech loudspeaker until the SLM is registering 80dBA.

8. Deliver the next speech list at **X** with the noise at **Y** with the transmitter in the correct position.

9. Calculate the improvement by comparing the scores between the two tests in noise-i.e. with and without the radio aid. This measures the advantage of the radio aid.

10. Evaluate the results and **use the data** to show the benefit of the radio aid system For example the SNR conditions can be used to simulate the actual classroom conditions, across the course of a school day and can show the impact of noise. The data can be used diagnostically to support listening and language development and appropriate interventions

If there is no significant benefit this may be due to hearing instrument compression effects so consider using the 'at distance' procedure; this is currently being validated.

Note: this is one standardized procedure. Whatever you use ensure that all parameters are kept the same if you wish to compare data at a later date**.** The more tests performed, then averaged, in each status, the greater the confidence in

the results. **Remember calibration and measuring sound levels are key.**