Authors' objectives
To assess the clinical and cost-effectiveness of developments in hearing aid technology, in particular digital hearing aids, compared with the current NHS analogue hearing aid range.

Searching
MEDLINE, EMBASE, the Science Citation Index (SCI), the Cochrane Database of Systematic Reviews, the Cochrane Controlled Trials Register, DARE, NHS EED, and HTA were searched electronically without any restriction on the date or language. The keywords used to search MEDLINE were listed in an appendix, whilst those for other databases were available from the authors. The National Research Register, the MRC Clinical Trials Directory, Current Research in Britain, and the US National Institutes of Health trials register (clinicaltrials.gov) were also searched. The publication lists and current research registers of health technology assessment and guideline producing organisations, funding bodies, consumer groups and hearing research organisations were examined. Citation searches of the included studies were undertaken using the SCI search facility, and reference lists of the included studies were also checked.

Study selection
Study designs of evaluations included in the review
To assess clinical effectiveness, randomised controlled trials (RCTs), including randomised crossover trials, were eligible for inclusion. Pseudo-randomised (i.e. not truly randomised) trials were among the included studies.

Specific interventions included in the review
Hearing aid technologies. To assess clinical effectiveness, studies that compared two or more hearing aid technologies were eligible for inclusion, although the focus of the review was on comparisons of digital versus analogue (or 'conventional linear') hearing aids. The analogue devices used in the majority of the included studies generally appeared to be more sophisticated than conventional linear (NHS-type) devices. The period of familiarisation with each device in the included studies was 0 to 9 weeks. The follow-up ranged from none, to 6 to 9 weeks.

Participants included in the review
Impaired hearing. To assess clinical effectiveness, studies in hearing impaired individuals were eligible for inclusion. People with mild to severe hearing impairment were included in the review of digital versus analogue hearing aids. All but one study, which did not specify the age of the participants, were in adults.

Outcomes assessed in the review
To assess clinical effectiveness, studies were included if they used either an objective laboratory hearing and speech test or a self-report disability and quality of life questionnaire. The included studies measured various laboratory, questionnaire and self-report measures detailed in the report.

How were decisions on the relevance of primary studies made?
Two reviewers independently applied the inclusion criteria to abstracts of the studies identified, and any disagreements were resolved by consensus. The full papers were obtained when there was insufficient information in the abstract. The authors were contacted for further information where necessary.

Assessment of study quality
The quality of the studies comparing digital to analogue devices was assessed according to: the method of randomisation; blinding; attrition; intention to treat analysis; power calculation; and the validity of outcome measures. Other studies that met the inclusion criteria, but did not compare digital versus analogue devices, were not quality assessed. The quality of the studies comparing digital and analogue devices was assessed by one reviewer and checked.
The data from studies comparing digital and analogue devices were extracted by one reviewer and checked by another. The data extracted included: author; country; study design and quality; population; make and fitting of digital and analogue hearing aid; outcomes; follow-up; and results. The results were presented as ‘analogue no different to (A=D), better than (A>D) or worse than (D>A) digital’ based on the statistical significance at the 0.05 level. Data were not extracted from those studies that met the inclusion criteria but did not compare digital and analogue devices.

Methods of synthesis
How were the studies combined?
A qualitative analysis was undertaken of studies that compared digital with analogue hearing aids. The results were not pooled across the studies, due to the poor reporting of detailed numerical results and heterogeneity among the study outcomes. Comparisons of technologies that did not include digital versus analogue devices were listed in an appendix, as were studies for which the methodological details were unavailable at the time the report was written.

How were differences between studies investigated?
The authors appear to have made a qualitative assessment of differences between the studies based on the tabulated extracted data, and made a specific comment on the heterogeneity of outcome measures.

Results of the review
Eight RCTs (n=378), of which seven used a crossover design, were included in the assessment of clinical effectiveness of digital versus analogue hearing aids.

The included studies were small and of relatively poor quality: none of the studies described the method of randomisation, the blinding of outcome assessors, or the calculation of the sample size. No difference was shown between analogue and digital hearing aids, based on tests of hearing for speech (or speech perception). There was some evidence of a benefit of digital over analogue devices in a number of user self-reported measures, but this was not consistent within or across the studies. One study reported a benefit of analogue over digital devices in one outcome (audibility index at 80 dbHL).

Cost information
Comparative studies that included a cost analysis or economic evaluation were included in the review. One cost-effectiveness analysis reported a range of incremental cost-effectiveness ratios from US$558 to 1,090 per unit gain of hearing benefit. Two of the cost-utility analyses identified did not compare analogue versus digital hearing aids.

Authors' conclusions
The evidence base comparing the clinical effectiveness of digital and analogue hearing aids was small and of relatively poor quality. There was little or no evidence from laboratory or user-based outcomes of a clear consistent benefit of digital devices over analogue ones.

CRD commentary
This review addressed a clear clinical question in terms of the participants, study designs and outcomes of interest. However, the inclusion criteria for the intervention were misleading, being much broader than the comparison actually subjected to systematic review (digital versus analogue hearing aids). A good range of sources were searched for relevant studies, including existing systematic reviews and ongoing trials. By not restricting their search by date or language, the authors are less likely to have missed earlier or foreign studies. The potential for publication bias was not mentioned in the report.
The study selection, data extraction and quality assessment were conducted by more than one reviewer, or checked by a second reviewer, to minimise bias and errors. The included studies were assessed systematically for quality using criteria appropriate to RCTs, although features specific to crossover trials were not assessed. The characteristics of the included studies were tabulated clearly, but condensing the results to A=D, A>D or D>A based on p-values does not allow the reader to judge the clinical significance of each study's results. It was appropriate not to pool the data numerically, but the authors' 'qualitative analysis' was not adequately reported in the text of the review.

The authors’ conclusions appear to be consistent with the evidence presented.

This review has also been published as a journal article (see Other Publications of Related Interest).

**Implications of the review for practice and research**

Practice: The authors did not state any implications for practice.

Research: The authors state that further research is needed, preferably in NHS service settings, with well-designed controlled trials to measure objective outcomes (e.g. speech recognition) and validated measures of hearing-specific quality of life. Also, there is a need for a systematic review of the evidence of other technological advancements in hearing aids.

**Bibliographic details**


**Other publications of related interest**


**Indexing Status**

Subject indexing assigned by CRD

**MeSH**

Acoustic Stimulation /instrumentation; Cost-Benefit Analysis; Equipment Design; Hearing Aids /economics; Hearing Disorders /economics /therapy; Signal Processing, Computer-Assisted

**AccessionNumber**

12002008447

**Date bibliographic record published**

30/09/2002

**Date abstract record published**

30/09/2002

**Record Status**

This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.