Trends in educational placement and cost-benefit considerations in children with cochlear implants

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Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
Multiple-channel cochlear implantation accompanied by aural rehabilitation (at least 1 year of a systematic auditory skill development programme) in school-aged children with prelingual profound hearing loss.

Type of intervention
Treatment and rehabilitation.

Economic study type
Cost-effectiveness analysis.

Study population
School-aged children with prelingual profound hearing loss without other clearly defined disabilities.

Setting
Hospital and community. The economic analysis was carried out in the USA.

Dates to which data relate
Effectiveness and resource use data corresponded to the academic year of 1996-1997 for children who underwent cochlear implantation before December 1996. The price years used were 1995 and 1997.

Source of effectiveness data
The evidence for the final outcomes was based on a single study.

Link between effectiveness and cost data
Costing was conducted retrospectively on the same patient sample as that used in the effectiveness analysis.

Study sample
Power calculations were not used to determine the sample size (some retrospective power calculations were performed to find out the sample size required to acquire the necessary statistical power to show significance). The implanted group consisted of 35 children with a mean (SD) age of 5 years 2 months (3 years) enrolled in special education programmes or mainstream classrooms between kindergarten and 12th grade in regular US public schools. A representative non-randomised sample of 10 children with comparable levels of hearing loss that did not have cochlear implants was selected from a 'total communication' programme in the US public school system.
Study design
This was a retrospective cohort study, carried out in a single centre. The duration of the follow-up was not explicitly reported although 2 years of postoperative rehabilitation was specified. Loss-to-follow-up was not reported. Longitudinal data for the control group were obtained retrospectively for US educational grades corresponding to ages 5, 8, and 11 years. Data on educational placement and the use of special educational support services were obtained through school consultations, interviews with parents, and a review of individualised educational plans.

Analysis of effectiveness
The principle (intention-to-treat or treatment completers only) used in the analysis of effectiveness was not explicitly specified. The clinical outcome measures were classroom placement and number of hours of special educational support used (as a measure of educational independence). The control group had similar educational placement and support service use to those of the intervention group before the latter group's surgery. When the children were stratified by age at implantation, there was a close approximation in ERM (an educational resource matrix designed to quantify the use of educational resources by hearing-impaired children) distribution between those receiving implants (before surgery) and those not receiving implants in the 4- to 6-year-old and the 7- to 9-year-old age groups. The small number of children receiving implants after age 9 years hampered meaningful comparison of this older age group.

Effectiveness results
The effectiveness results were as follows:

A correlation was observed between the length of cochlear implant experience and the rate of full-time placement in mainstream classrooms ($r=0.939; p=0.008$).

There was also a negative correlation between the length of implant experience and the number of hours of special educational support used by fully mainstreamed children (Pearson product moment correlation = -0.999; $p=0.03$).

Children with greater than 2 years of implant experience were mainstreamed at twice the rate or more in comparison with age-matched children with profound hearing loss who did not have implants.

They were also placed less frequently in self-contained classrooms and used fewer hours of special education support ($z=2.91; 95\% \text{ CI: } -1.30 \text{ to } -0.36; p=0.004$).

Clinical conclusions
Preliminary evidence indicates that cochlear implantation accompanied by aural rehabilitation equips most children with an increasing ability to participate in and benefit from the mainstream classroom. The diminished use of support services appears to be consistent through middle school, suggesting a sustained effect on language development that equips adolescents to address the academic challenges of higher grade levels.

Measure of benefits used in the economic analysis
No summary benefit measure was identified in the economic analysis, and only separate clinical outcomes were reported.

Direct costs
Costs were discounted. Resource use quantities were reported separately from the costs and cost items were reported separately. Cost analysis covered the costs of educational placement (from mainstream placement within a neighbourhood school to residential placement at a state school for the deaf), support services (hours of daily intervention provided in addition to classroom instruction for academic remediation and enhancing verbal communication, such as speech or language pathologists, educational audiologists, etc.), and cochlear implantation (including preoperative evaluation, hardware, operative fees, and 2 years of postoperative rehabilitation). The net present cost of cochlear implantation and education from kindergarten to 12th grade was calculated for 4 different
educational scenarios that reflect trends in the use of educational resources observed in the present study (applied to hypothetical children having cochlear implants at ages 3 and 5 years). The cost analysis for the comparator procedure was based on two scenarios (showing the costs of 13 years of education for a day and a residential student at a state school for the deaf). The perspective adopted in the cost analysis was not explicitly specified. The sources of cost data were the local or study institutions. The price years were 1995 and 1997.

**Indirect Costs**
Not included.

**Currency**
US dollars ($).

**Sensitivity analysis**
Not conducted.

**Estimated benefits used in the economic analysis**
Not applicable.

**Cost results**
The discount rate was 5%. The cost savings associated with the intervention (cochlear implantation accompanied by appropriate auditory rehabilitation) as compared with the conventional amplification without implants ranged from $30,000 to $200,000.

**Synthesis of costs and benefits**
Costs and benefits were not combined since the use of the intervention procedure was the dominant strategy.

**Authors' conclusions**
Cochlear implantation accompanied by aural rehabilitation increases access to acoustic information of spoken language, leading to higher rates of mainstream placement in schools and lower dependence on special education support services. The cost savings that result from a decrease in the use of support services indicates an educational cost benefit of cochlear implant rehabilitation for many children.

**CRD COMMENTARY - Selection of comparators**
A justification was given for the choice of the comparator as it was the conventional method used in the context in question. You, as a database user, should consider whether this is a widely used health technology in your own setting.

**Validity of estimate of measure of effectiveness**
The internal validity of the effectiveness results cannot be guaranteed due to the retrospective nature of the study design and the small sample size. The control group had similar educational placement and support service use to the intervention group before the latter group's surgery. The roles of potential confounding variables were not investigated (as acknowledged by the authors); a child's placement and rate of progression to educational independence may be subject to parental choice and assertion rather than standard district placement policy or academic or communication competence. Despite being unable to assess the effects of age at implantation on trends in educational independence, the authors speculated that children receiving implants before age 3 years will have the language skills on which literacy can be built more quickly, permitting early mainstream placement and a diminished need for educational support services. The degree to which the study sample was representative of the study population cannot be assessed as
insufficient information was provided regarding the inclusion and exclusion criteria adopted in the study.

Validity of estimate of measure of benefit
The authors did not derive a summary measure of health benefit. The study was therefore a cost-consequences analysis.

Validity of estimate of costs
Good points regarding the cost analysis were that: resource use quantities were reported separately from the costs; adequate details of methods of cost estimation were given; price years and discount rate were given. However, the perspective adopted in the cost analysis was not specified. Regarding the issue of the comprehensiveness of the cost analysis (inclusion of all relevant cost items), it was reported that the cost figures were based on extremely conservative estimates of costs of education in Maryland public schools; for example, these estimates do not include the costs of transportation to regional or distant schools that provide the required special education support services, and they do not take into account the costs of hearing aids and other communicative adjuncts. Additionally, the effects of alternative procedures on indirect costs were not addressed. Statistical analyses were performed on resource use data, but not on cost data. Other limitations of the study were that no adjustments appear to have been made for inflation, and the cost results may not be generalisable outside the study settings.

Other issues
Given the retrospective nature of the study design, lack of sensitivity analysis and statistical analysis of the costs, the study results should be treated with some degree of caution. The issue of generalisability to other settings or countries was not addressed, but appropriate comparisons were made with other studies. The degree to which the study sample was representative of the study population was not discussed. It was noted that this study did not attempt to examine how decisions on placement and the use of special education services were made, and whether or not they were appropriate. The authors point out that a cost-utility framework may have been a more appropriate analytic approach in the context in question.

Implications of the study
A longitudinal prospective study of a large sample is needed to determine the effect of age at implantation on educational independence. Properly matched and randomised comparison groups will be necessary so that the effects of cochlear implantation and aural rehabilitation on educational independence can be separated from the influence of socio-economic status, cognitive function, age of diagnosis of deafness and language intervention, and the mode of communication. The effects of intervention on quality of life should also be investigated where possible.

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