An economic model of adult hearing screening

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Background

Populations are ageing and older adults make an increasing contribution to society, yet uncorrected hearing loss is common over the age of 50 years, increasing in prevalence and severity with age. The consequences of uncorrected hearing loss can be profound for hearing-impaired individuals and their communication partners but there is evidence that adults commonly delay 10-15 years before seeking help for hearing difficulty (Stephens et al., 1990; Davis et al., 2007) and the most common reason is the belief that their hearing is not bad enough (Ipsos-Mori/RNID survey, 2005). Hearing aids are currently the mainstream of intervention for hearing loss; evidence shows benefit to social functioning and quality of life even for mild hearing loss (Mulrow et al., 1990; Chisolm et al., 2007) and long-term outcomes are better when they are obtained early (Davis et al., 2007). Screening adults for hearing loss would expedite intervention and reduce unmet need, leading to improved quality of life for many older adults. Previous work suggests adult hearing screening (AHS) should target adults aged 50-65 years, old enough for prevalence to justify screening but young enough to gain from early intervention (Stephens et al., 1990; Davis et al., 1992, Davis et al., 2007). Hearing aid acceptance and benefit after screening is largely dictated by better ear average (BEA) hearing threshold level averaged over the frequencies 0.5, 1, 2 and 4 K Hz (Davis et al., 1992). The mean BEA of those accepting intervention after screening was 30 dB HL and 32 dB HL (Stephens et al., 1990; Davis et al., 2007). Over 95% of those fitted post-screen showed benefit and 90% continued using hearing aids after 2 years (Davis et al., 1992). A recent UK Health Technology Assessment (HTA) report (Davis et al., 2007) concludes that AHS is acceptable and beneficial to 55-74 year olds and that an audiometric screen for BEA ≥35 dB HL is most appropriate. A detailed analysis of the cost-effectiveness of AHS is required. The present study uses decision analysis to compare possible AHS programmes with each other and with the current GP-referral service. The aim is to establish whether AHS could offer additional benefits at acceptable cost, compared to current provision and, if so, to investigate which type of screening programme could provide most benefit at acceptable cost.

Methods

Evidence from the literature is synthesised in Markov models that simulate adult hearing screening scenarios and current UK National Health Service (NHS) provision for hearing-impaired adults (GP-referral to an audiology service). The models represent twelve screening scenarios that vary according to age at first screen (first screen at age 55, 60 or 65 years; subsequent screens would be offered 5-yearly), target hearing loss (better ear average ≥30 dB HL or ≥35 dB HL) and screening programme type (one- or two-stage screening programme).

The perspective on costs is NHS costs and benefit is expressed in terms of utility gain from receiving the intervention (hearing aids). The time horizon for the analysis is from first screen until age 85. For each screening scenario a cohort of 100,000 adults is modelled and an incremental cost-effectiveness ratio (ICER) is calculated to compare each potential screen in turn to current NHS practice (GP-referral). An alternative method of analysis will be published elsewhere, where all potential screens are compared to one another and ranked by ICER. The models were developed in Microsoft Excel 2003.

A systematic search of the literature was conducted to provide estimates for the following input parameters:
- prevalence of hearing loss (Davis, 1995);
- prevalence of hearing aid ownership (Stephens et al., 1990; Davis et al., 1992, Wilson et al., 1993; Davis, 1995; Davis et al., 2007);
- sensitivity and specificity of screening tests (Davis et al., 2007);
- probability of accepting hearing aids after screening (Davis et al., 1992; Wilson et al., 1993; Davis et al., 2007);
- probability of using hearing aids within the first 5 years after screening (Davis et al., 1992);
- probability of continuing to use hearing aid after the first 5 years (Davis et al., 1992, Wilson et al., 1993; Davis et al., 2007);
- utility from hearing aids (Barton et al., 2004; Davis et al., 2007);
- probability of mortality (UK Government Actuary’s Department Interim Life Tables 2005-6).

Costs are estimated for a steady-state service; set-up costs are not included. Cost estimates are based on the 2009/10 Adult Hearing Services Indicative Tariff (Department of Health, 2009). Costs for a full package of care (assessment, hearing aid fitting, hearing aid device/s, follow-up and repair) are counted for each 5-year cycle for all hearing aid users. The effects of uncertainty related to parameter and cost estimates are evaluated with one-way and probabilistic sensitivity analyses.

Results

By implementing AHS, up to 30,000 Quality-Adjusted Life Years (QALYs) could be gained per 100,000 cohort, compared to around 17,000 gained via the current GP-referral. One-stage screens, screens starting younger and screens for milder hearing loss provide greatest QALY gain. The total cost of identifying and treating hearing loss in older adults is estimated to be £21 million per 100,000 cohort under
current GP-referral arrangements over the time horizon of the analysis; introducing AHS would cost up to $38 million per 100,000 cohort. Incremental Cost-Effectiveness Ratio (ICER) results for each screening scenario compared to the baseline of current NHS GP-referral service are $1,266 to $2,185 (Figure 1).

One-way sensitivity analysis shows that uncertainty surrounding the majority of parameters have a modest effect on cost per QALY of the overall programme. The only parameter that has a material effect on cost per QALY is utility gain from hearing aids. Cost per QALY varies between around $800 and $2,500 depending on the utility estimate used. Probabilistic sensitivity analysis reveals that 95% of ICER results fall between $752 and $2,090.

Discussion

Assuming willingness-to-pay up to $20,000 per QALY, models show that all approaches to identifying and treating acquired hearing loss in older adults are cost-effective, but a large number of QALYs could be gained by improving identification and treatment. All screening programmes offer greater gains at greater costs compared to GP-referral, with favourable ICER values around $1,000-$2,000. There is little variation in the value for money of alternative programmes, expressed by ICER and cost per QALY. Looking at the marginal differences, programmes targeting milder hearing losses offer the most favourable ICERs, and one-stage screens provide slightly better value than comparable two-stage programmes. Sensitivity analyses show that the risk of AHS exceeding a cost per QALY of $20,000 is vanishingly small.

Hearing aid provision is assumed as the preferred intervention in the current work as estimates of usage and utility gain are available in the literature, and hearing aids are currently the main form of intervention offered. However, long-term benefit and cost-effectiveness are optimised by providing a broad programme of rehabilitation, rather than simply prescribing amplification (Brooks, 1979; Abrams et al., 2002) and this is expected to be particularly important when offering intervention to adults with active lifestyles and milder hearing loss than currently seek intervention via GP-referral.

The acceptability of hearing aids to the target population has been an enduring issue in this area of work. The present study uses estimates of 61% and 66% (for BEA ≥30 and 35 dB HL, respectively) for take-up of hearing aids after screening, based on an average of the estimates from studies by Davis et al. (1992; 2007) and Wilson et al. (1993). It is worth noting that these studies predominantly prescribed analogue hearing aids and were carried out before open canal fittings were available. Open canal fittings are expected to improve the acceptability of hearing aids to those with mild-moderate high frequency hearing loss, and preliminary evidence supports this (Kuk et al., 2005; Smith et al., 2008). However, sensitivity analysis shows that even under a worse-case-estimate of 46% take-up (lower 95% confidence interval across all studies), screening remains cost-effective, and in fact this variable has a negligible effect on cost per QALY within the modelled range.

Evidence of long-term hearing aid use is scarce. The model estimates that 62% (sensitivity analysis range 46-77%) of those with BEA ≥30 or 35 dB HL who accept hearing aids would continue to use them for longer than five years (based on Davis et al., 2007). Gianopoulou et al. (2002) found only 43% of those who accepted hearing aids were still using them 8-16 years after screening, although this sample were fitted using a liberal criterion for the time of worse ear average ≥30 dB HL. They found that rejection of hearing aids could have been avoided by simple measures in the majority of cases and 47 of 66 who rejected them were willing to try again. Tailoring interventions to individuals’ communication needs and providing appropriate after-care has the potential to achieve much higher rates of long-term benefit. However, the model shows that AHS is cost-effective even without further improvements in long term usage rates.

There is a need to de-stigmatize hearing loss by promoting its assessment and treatment (Wallbagen, 2009). Stephens and colleagues (1990) predict that when hearing aids are used by comparatively young people the stigma will be reduced, and this in turn will encourage others who could benefit. So, whilst AHS itself may help to encourage others who could benefit. The aim should be for hearing loss to be accepted as a normal part of healthy ageing and for communication rehabilitation to be seen as routine in an era where people expect to participate in society well beyond the age when hearing typically begins to decline.

Conclusions

Hearing screening is cost-effective and offers excellent value. A one-stage screen for bilateral hearing loss ≥30 dB HL from age 55 offers the best potential public health gain and would be a cost-effective means of improving participation and quality of life for older adults.

References


Barton G, Bankart J, Davis A, Sumerfield Q. 2004. Comparing utility scores before and after hearing aid provision: Results according to the EQ-5d, HUI3 and SF-6d. Appl Health Econ Health Policy. 3(2):103-105.
