Evaluation of early screening for hearing disability against NSC Handbook Criteria
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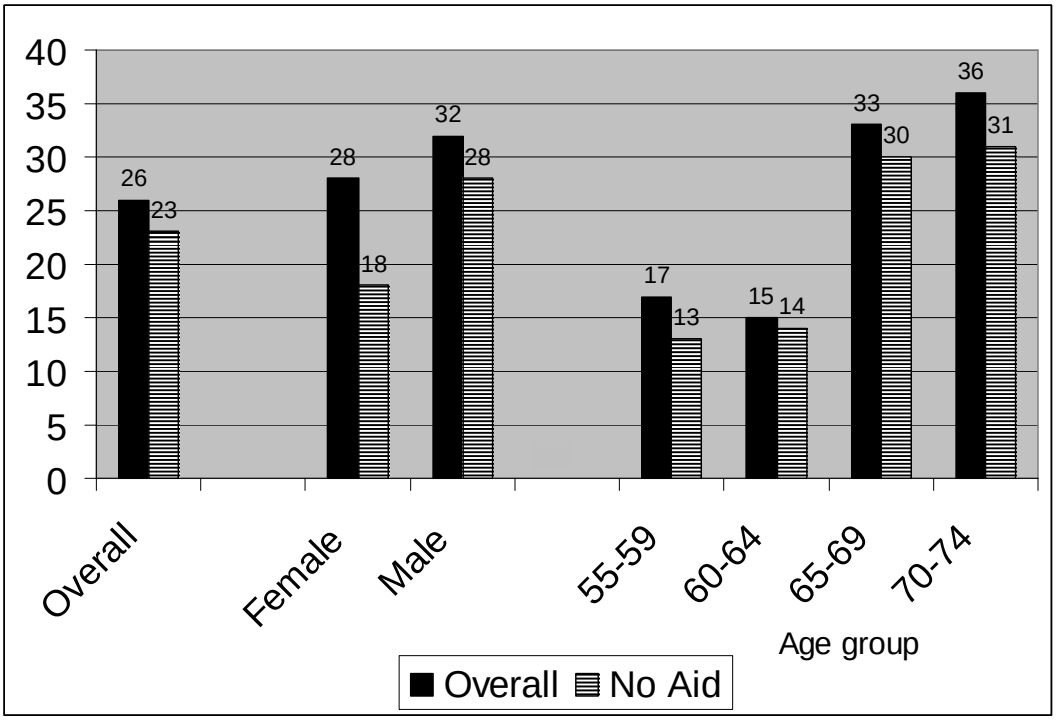
1.0 Introduction

Acquired hearing loss remains a significant public health issue, with many affected individuals remaining untreated, or only seeking treatment at a late stage when the efficacy of intervention may be compromised. In this review the findings of the report "**Acceptability, benefits and costs of early screening for hearing disability: a study of potential screening tests and models"** (Davis et al., 2007) are evaluated against the National Screening Committee criteria for implementation. Additionally, peer review literature publications since the issue of the report regarding early screening for adult hearing disability are reviewed.

2.0 Key findings of Hearing Disability HTA

The key findings of the early screening for hearing disability HTA were as follows. Hearing impairment of moderate degree in adults is a highly prevalent major public health problem with a large impact on people's lives, that is left too late before access to services is achieved. One in ten people aged 55-74 years are substantially impaired and would benefit from referral. Lack of intervention impacts on activity and causes substantial participation restriction (handicap) in older people. Amplification gives substantial benefit to these people and this benefit can be realised by provision of good quality hearing aids to people with this high degree of need. The prevalence of hearing impairment with age as determined by the HTA is indicated in Figure 1.



Percentage of population with a significant hearing impairment at 0.5, 1, 2 and 4kHz on any ear using a criterion of 35 dB HL or greater as a function of gender, age and aided status (aid or no aid) (Davis et al., 2007).

A simple systematic screen, using an audiometric screening instrument has been shown to be acceptable to people in the age range 55-74 years and provides substantial benefits at very reasonable cost effectiveness for those in the target group who are placed in an appropriate patient journey.

A screening programme was proposed, which was felt to meet the NSC criteria provided screening would be targeted at those with at least 35 dB HL better ear average (0.5, 1, 2, 4kHz). In addition if screening were targeted on the younger age range, it would identify more people who are currently not likely to self refer, where the additional benefits (e.g. from 10 years earlier identification) are more likely to be found. However, it should be noted that its benefit is not solely restricted to this group at present (as older people who would greatly benefit have not had any screening and have not self referred).

The following further research recommendations were made in the HTA:

1) Prospective RCT study of one and two stage hearing screen to identify bilateral 35+ dB HL hearing impairment in 60-70 year old people and intervene in a PCT setting using current NSH hearing aids (BTE)
2) Development and trial of simple, low cost, audiometric screening device.
3) Prospective pilot of hearing screen triage to identify people who should be referred for and benefit from audiological assessment and provision of hearing aid in a PCT setting.
4) Trial of a 'Hearing Direct', telemedicine, alternative to questionnaire combined with a low cost audiometric screen device.
5) Workforce review to estimate the impact of introducing the screen on the audiological workforce in general and to look at the workforce requirements for different levels of staff to assist patients through the patient journey.
6) Modelling of different screening programmes and their cost and financial impact.

3.0 Review against NSC criteria

Criteria	Supporting Evidence
<u>The condition</u>	
1. The condition should be an important health problem	The aim of evaluation of early screening for hearing disability is to improve take up rates of amplification in persons aged 55-70, and thereby increase quality of life for those affected and their families. The evidence that hearing impairment, if untreated, is associated with reduced quality of life for both the affected individual and their family is compelling (see Chisholm et al., 2007 for systematic review). Further, there is emergent evidence from auditory neuroscience studies that late intervention for hearing impairment is less effective in achieving an increase in hearing abilities (Moller, 2006). It seems a reasonable assumption that increased quality of life in the hearing impaired population would result in reduced reliance upon state support as people maintain economic and social functioning (Joore at al., 2003).
2. ***i) The epidemiology of the condition should be known*** ***ii) The natural history of the condition should be understood.*** ***iii). There should be a***	i) Evidence regarding the prevalence of hearing impairment in the target age range is robust, and the HTA report represented a significant contribution to the literature in that regard. The major risk factors are age and noise exposure, these having an additive effect. The situation regarding incidence is less clear. The HTA report correctly notes that it can take up to a decade for an affected individual to recognise that they have a hearing problem, and then to seek advice or help for that matter. The factors that trigger this presentation are not well understood, and whilst the HTA report contains some data in this regard (Figure 3, p 29) further work in this

recognised latent period or early symptomatic stage.	area is needed. The HTA report was written in a context of an appalling waiting list situation for Audiology services in the UK, with 250,000 individuals waiting for either a first assessment or a reassessment of a hearing loss. Since that time Audiology services have been included in the Department of Health waiting times framework, such that no individual may wait for more than 6 weeks from referral for a diagnostic test, and a total of 18 weeks from referral to treatment. These targets have been achieved across England. As such, an individual who recognises that they have a hearing impairment will now be assessed in a timely fashion. It will take some time before this is widely understood, but when it is it may impact upon age of presentation for hearing aid care by younger people who previously would have delayed this, put off by the long waits. ii. The natural history of age related hearing loss is well understood, with robust evidence regarding the progression of the condition being available. iii. As stated above there is a latent period wherein an affected individual will often fail to recognise that a hearing impairment has developed: this period may approximate a decade. During this time there may be a deterioration in social functioning, and in some cases may be associated with a reduction in the quality of family life, and in a minority of cases with depression and social isolation.
3. All cost-effective primary prevention interventions should have been implemented	Given that the two major risk factors are age and noise exposure, the first of these is not amenable to prevention. Regarding noise, legislation is now in place regarding occupational noise, and leisure noise from concerts and clubs is also regulated. Social noise from

as far as practicable.	wearable music players does represent an additional risk, and research and public information programmes seek to inform the public of their vulnerability in this regard (Baguley and McCombe, 2008).
The Test	
4. There should be a simple, safe, precise and validated screening test	It was the intention of the HTA report to assess several different tests and models of screening for hearing disability, and a large amount of data was accrued and analysis undertaken. The tests used included questionnaires, objective tests of auditory function (specifically distortion product otoacoustic emissions), and screening audiometry. Models of screening evaluated included questionnaires received by post, available in a GP waiting room, or handed out by Primary Care Practice staff, followed by audiometry (screening or full). The findings indicate that further work is needed in this area, but that the optimal approach is likely to consist of a short questionnaire (two questions) and screening audiometry at 3kHz. Detail on sensitivity, specificity and positive predictive value data for this screen is not yet available.
5. The distribution of test values in the target population should be known and a suitable cut-off level defined and agreed.	As there is further work to be done regarding the determination of the optimal screen methods and model from the options evaluated by the HTA report, a final determination of test values in the target population is not yet possible. What has been achieved in the HTA report however is a robust determination of a suitable cutoff level for screening audiometry to identify those individuals who are most likely to benefit from the provision of digital hearing aids. The value of 35dBHL at 3kHz has face validity clinically and is supported by the analysis of data within the HTA report.
6. The tests should be	The HTA contains data indicating that hearing screening is acceptable

acceptable to the population.	to the overwhelming majority (>80%, strand 1, p33) of the target population, especially when the screen is linked with their local GP. A proportion of people would be nervous about a hearing screen (13%, strand 1, p33).
7. There should be an agreed policy on the further diagnostic investigation of individuals with a positive test and on the choices available to those individuals.	Recent work by the Department of Health has led to the development of a Commissioning Pathway for adults with acquired hearing impairment, and Good Practice documents have been produced. Thus clear and explicit guidelines exist to inform effective and timely intervention in the target population, and these are applied consistently across England.
<u>The treatment</u>	
8. There should be an effective treatment or intervention for patients identified through early detection.	Binaural digital hearing aid provision is the treatment of choice for age related hearing loss, and there is a robust evidence base in support of this (Chisholm et al., 2007 for systematic review). An issue of concern is raised by strand 3 within the HTA report. In this study an attempt was made to ascertain the proportion of individuals who had been fitted with hearing aids following a hearing screen programme (at age 50-65 years) and who were long term device users (8-16 years post screen). Only 43% of those sampled (total n= 116) were device users – and that by lax criteria ("… categorised as hearing aid users even if the only used an aid for a limited period of time, as long as they used it at least once a week" p98). It should be noted that the devices used were poor quality analogue hearing aids, and that there seems to have been no reassessment of prescription needs over time, but the issue of

	potential low take up is real.
9. There should be agreed evidence based policies covering which individuals should be offered treatment and the appropriate treatment to be offered.	The Commissioning Pathways and Good Practice Guidelines produced by the Department of Health contain these policies and protocols. Adult hearing screening is not explicitly mentioned in these documents, but a screening programme would be congruent with the aims and practice contained therein (Department of Health, 2007).
10. Clinical management of the condition and patient outcomes should be optimised by all health care providers prior to participation in a screening programme.	Recent work by the Department of Health has led to the development of a Commissioning Pathway for adults with acquired hearing impairment, and Good Practice documents have been produced (Department of Health, 2007). Thus clear and explicit guidelines exist to inform effective and timely intervention in the target population. These recently published guidelines are presently being implemented by the Audiology clinical community.
<u>The Screening Programme</u>	
11. There should be evidence from high quality Randomised Controlled Trials that the screening programme is effective in reducing mortality or morbidity.	In each of the 3 strands of evidence provided within the HTA report there has been effort to ensure rigorous experimental design, and in each case there has been randomisation and case-control where-ever possible. RCT evidence does not exist elsewhere to the best of my knowledge.
12. There should be evidence that the	The only novel element of the programme is the screening element: the remainder (e.g. NHS hearing aid provision) has been in place for

complete screening programme (test, diagnostic procedures, treatment/ intervention) is clinically, socially and ethically acceptable to health professionals and the public.	some time, and has been clinically, socially and ethically acceptable to health professionals and the public. The HTA report contains evidence that the screening element would also be acceptable. Focus groups of professionals were consulted, and acceptability of a screen for hearing disability was high. Regarding evidence of acceptability to patients : one concern is the low take up of the hearing screening opportunities offered in strand 2 (chapter 3). For example, only 53% of screening questionnaires taken were completed and returned (strand 2, 60). This might represent lack of enthusiasm rather than poor acceptability.
13. The benefit from the screening programme should outweigh the physical and psychological harm (caused by the test, diagnostic procedures and treatment).	The potential benefits of early screening for hearing disability are significant: the potential risks are minimal. Some individuals may have some anxiety about the screening test (estimated at 13% in the HTA, strand 1, p33) but this is unlikely to be long lasting or substantial.
14. The opportunity cost of the screening programme (including testing, diagnosis and treatment) should be economically balanced in relation to expenditure on medical care as a whole	The cost of an early screening for hearing disability programme in the UK consisting of a 2 item questionnaire and an audiometric screen at 3kHz (35dBHL cutoff) has been estimated at £13 per person screened, or £100 including treatment costs and as such is balanced with regard to medical expenditure as a whole (HTA, xi). Further work is needed to determine the real world cost of the screen.
15. There should be a plan for managing and	In the absence of national early screening for hearing disability in the UK, no quality assurance standards have yet been agreed.

monitoring the screening programme and an agreed set of quality assurance standards.	Establishing consensus in this regard from patient and professional organisations would not be difficult with present networks.
16. Adequate staffing and facilities for testing, diagnosis, treatment and programme management should be available prior to the commencement of the screening programme	The recent achievement of the 6 and 18 week waiting time targets in Audiology have demonstrated the ability of the service to respond to changes in demand. Implementation of national early screening for hearing disability in the UK would have two effects: - the earlier presentation (and hence an increase in demand) of individuals who would have eventually been provided with hearing aids in any case - increase in overall incidence of presentation and management of hearing impairment The required increases in capacity consequent upon such increase in demand would need to be managed at a national level.
17. All other options for managing the condition should have been considered (e.g. improving treatment, providing other services) to ensure that no more cost-effective intervention could be introduced or current interventions increased within the resources available	There are no other reasonable options for managing age related hearing loss other than those which have been considered. The effect of two additional factors has yet to be determined: - the influence of Audiology becoming a zero-wait service on age of presentation with age related hearing loss - the influence of public perception of the improved quality of hearing aids on the incidence of presentation and the age of presentation Both of these factors are likely to reduce age at presentation and to increase incidence of presentation by an extent that is hard to determine, but that is very unlikely to be in the order of magnitude of that achieved by national early screening for hearing disability in the UK.

18. Evidence-based information, explaining the consequences of testing, investigation and treatment, should be made available to potential participants to assist them in making an informed choice	Good quality information is readily available to support individuals who are seeking a hearing assessment, and/or about to wear hearing airs for the first time: this has been produced with patient organisations such as the RNID.

4.0 Literature published since the HTA report

Literature published since July 2006 was reviewed (25.9.08) using Medline (www.pubmed.com) and the key words: ***Hearing, screening, adults***. A total of 1701 published items were identified: on review 11 were of significant interest. These were separated into two themes: ***epidemiology*** and ***screening.***

The epidemiology studies essentially corroborate data already available for the UK population in the National Study of Hearing (Davis, 1994). Chang and Chou (2007) studied a randomly selected population of elderly people (>65y) in Taiwan using a questionnaire and pure tone audiometry. Hearing thresholds worsened with age, and using a criteria mean thresholds at 0.5, 1 and 2kHz >or+55dBHL, only 18.4% of such people used hearing aids. Mattos and Veras (2007) prospectively studied a population sample of 238 elderly people (>+65y) in Rio de Janiro, and found prevalence of hearing loss congruent with UK data (Davis, 1994)., as did Blanchet et al. (2008) testing an elderly French population. Abel-Hamid et al. (2008) conducted a national household study of 4000 individuals regarding hearing, and found marked differences in the prevalence of hearing impairment across the 6 geographically distinct areas that participants were drawn from. These differences may be due to sampling errors, but are worthy of further investigation and interest. In a more substantial study, Agrawal and

colleagues (2008) performed a national cross sectional study including audiometric testing. This was able to determine that the prevalence of hearing impairment (>25dBHL for frequencies 0.5, 2, 2, 4kHz) in the USA is higher that was previously considered (16.1%) – this equates to 29 million US individuals. An interesting finding was that the odds of hearing loss were considerably lower in black compared to white individuals. This finding is congruent with that of a 18.8% adjusted prevalence positive response to the question "Do you have difficulty with your hearing?" in the household study report ed in the HTA (p18).

Regarding papers that consider screening adults, for hearing disability, Torre and colleagues (2006) determined the sensitivity and specificity of a single question ("Do you feel you have a hearing loss?") in 59 older Latino-American adults, compared with findings on pure tone audiometry. Sensitivity and specificity were both acceptable (approximating 75%), and this study corroborates the approach of the HTA in utilising a very small number of direct questions as a hearing screen. The utility of a brief questionnaire instrument in adult hearing screening was also demonstrated by Ito et al. (2007):who found sensitivity and specificity data of 89 and 88% respectively – though it should be noted that this data derived from a University population rather than older people. Parving et al. (2008) evaluated a hearing screening device which used 1 and 3kHz tones at 20,35 and 55 SPL and 35,55 and 75dBSPL respectively. Sensitivity of the screen was 92% and specificity was 65%, and a positive predictive value of 87% was determined. The need for hearing screening in adults was supported by a study by Wallhagen and Pettengill (2008). On interviewing 91 older people with hearing impairment, in only 15% had there been direct physician enquiry about their hearing status. Danhauer and colleagues (2008) investigated the attitudes of primary care providers in California to screening for hearing and balance issues in the elderly . The study had a very low response rate (26.5%), and of those motivated to respond , very few showed awareness of any need for screening regarding hearing and balance. Issues of the acceptability of the method of delivering hearing screening were investigated by Koopman et al. (2008), finding that questionnaires were a more acceptable method to the public than internet screening.

Thus, literature published subsequent to the HTA report intends to support and corroborate the findings and conclusions. No dissonant findings of any significance were identified.

5.0 Conclusions of the Hearing Disability Screening Report

5.1 Implications for Policy

This review finds that further consideration of hearing screening in adults is an appropriate direction of travel, and is supported by all presently available evidence. Further work is needed to determine the optimal screen methodology, but this looks likely to include simple and direct questions, and a simple audiometric screen at an appropriate frequency.

5.2 Implications for Research

Further research is indicated, and should focus upon the formulation of an optimal hearing screening method, incorporating simple and direct questions, and a simple audiometric screen at an appropriate frequency.

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