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Cost implications for changing candidacy or access to service within a publicly funded healthcare system?

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Introduction: Undue attention in the allocation of healthcare resources can be given to expenditures as opposed to expenditures avoided. This can be particularly apparent when expenditures avoided fall across different budget holders and budgetary pressures are strained.

Methods: The paper presents estimates of the potential savings attributable to the adoption of new hearing assistive technologies in Britain between 1992 and 2014 based on multivariate analyses of survey data.

Results: The reduction in service use among the hearing impaired between 1992 and 2014 is estimated to amount to between £53 and £92 million per annum.

Conclusion: Issues in estimating the impact of widening candidature for cochlear implants on costs exist related to potential savings. This research begins to lay a firmer evidence base for such work as well as identifying some of the challenges.

Keywords: Hearing impairment, Costs, Economic burden, Cochlear implant, Health economics

Introduction

When discussing expanding the candidacy criteria for any technology, it is vital to consider the financial implications to society and not simply those that fall on any one budget holder. Only by so doing can we avoid making the potentially false economies that undue focus on one budget might give rise to. It is in part for this reason that economists examine changes in the economic burden of a condition associated with expanded candidacy rather than simply the impact on a particular budget.

The economic burden of a health condition is comprised of two parts: the financial cost arising from it and the monetary value of the lost quality of life associated with it. The financial cost can then be separated into two elements: those related to use of health and social care services (within publicly funded health care systems those that typically but not exclusively fall on the state) and non-health care related costs associated, for example, with lost output arising from absenteeism, early retirement, and premature death. Within publicly funded health care systems there is an understandable focus on the financial burden that the management of a condition typically generates for health and social

care. At times of financial stringency (such as those pertaining in most developed economies in the aftermath of the 2008/9 financial crisis and subsequent economic downturn (Maresso *et al.*, 2014) the focus on public expenditures can become particularly acute. There is the temptation to downplay or even ignore expenditure that falls in a different budget. This has the potential to impact adversely on the allocation of resources and budget decisions made which may appear to save money in a particular budget, but in fact increase the overall economic burden (Lamb *et al.*, 2015).

Studies of economic burden have become popular in part because they can help us understand both the magnitude and distribution of costs across different budgets and what impact particular resource allocation decisions might have on these. They throw into sharp relief the interconnectedness of budgets and how changes in one area can have unintended consequences in others. An examination of the costs of overweight and obesity in Ireland is instructive in this regard (Dee *et al.*, 2014). This revealed that while the healthcare costs associated with overweight/obesity were substantial (€437 million), not only were costs of lost production much larger (€865 million) but the bulk of healthcare costs arose from other health conditions such as cardiovascular disease rather than overweight/obesity *per se*.

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While a number of studies have examined aspects of economic burden in hearing impairment, these have focused on particular population sub-groups defined, for example, by age (Genther *et al.*, 2013) or the role specific causes such as disease or noise (Nelson *et al.*, 2005) have in its prevalence. The difficulty with such approaches is that important aspects of economic burden, lost production in employment for example, in studies among children and retired persons (Genther *et al.*, 2013) may not be particularly relevant to that population. Similarly, examining the role of specific causes may underestimate the complexity of situations that involve multiple causes. Constructing more complete estimates from such a patchwork of studies would require substantial assumptions that might undermine the credibility of the estimates produced.

Little is known about how changes in the availability and use of new hearing technologies might have impacted on the economic impact of hearing loss over time. Understanding what impact changes in candidature for cochlear implantation for example might have on the overall economic burden of hearing impairment might avoid an inappropriate focus on direct healthcare costs of increased access. Unless we know the direct and indirect costs of hearing loss and how these are distributed across budgets, there is a risk that the focus of funders will remain on the direct financial implications of increased access to the technology that results from changes in candidacy. This would ignore the possible savings to be made in other areas of public expenditure.

In this study we report on the economic burden of hearing impairment and changes in this between 1992 and 2009 using of survey data drawn from a representative sample of the population. The study provides tentative estimates on what impact increased access to technology between 1992 and 2009 has had on the societal economic burden of hearing impairment over time. Previous work has demonstrated in cost effectiveness analyses the potential value for money of cochlear implants for both children and adults (Bond *et al.*, 2009). Value for money in this context is assessed based on costs, savings and the monetary value associated with changes in health-related quality of life among recipients. Consistent with these findings and the increased uptake of these technologies over time (Raine, 2013) our hypothesis was that increased access to new technologies such as cochlear implants would reduce aspects of the economic burden of hearing impairment. In subsequent discussion, we examine the implications of our findings to assessing the cost associated with expanded candidature for cochlear implants (and therefore further increasing access to technologies) and how such estimates might be produced.

Methods

Subjects

To estimate the additional cost associated with hearing impairment in Britain and changes in this over time as new technologies became available and were accessed, data were taken from the British Household Panel Survey. This is a survey of members of UK households that followed participants in Britain from 1991 to 2009 and in the UK from 2001 until 2009.

Estimation

The incremental costs associated with hearing impairment were estimated using a series of multivariate regression analyses. The analyses take account of the impact on service use associated with other conditions – for example, heart disease or vision impairment – as well as socio-demographic factors that might impact on use. This approach allows us to isolate the additional impact on service use associated with self-reported hearing impairment against a baseline use one would expect to see for a typical individual. Socio-demographic factors controlled for were age, gender and education. Analyses were weighted to ensure the generalizability of results (Taylor *et al.*, 2010).

In total 12 conditions in addition to hearing impairment were included in the analyses as explanatory variables. These related to: mobility (i.e. issues with arms, legs etc.), vision, allergies, chest/respiratory, heart, digestion/stomach, diabetes, anxiety/depression, alcohol, epilepsy, migraine and 'other', the latter being a catch-all for conditions not detailed explicitly already. Each was included as a dichotomous variable in the regressions, equal to 1 if the person reported the health issue concerned and zero otherwise. In terms of other explanatory variables, education was specified as a dichotomous variable equal to 1 if the highest level of educational attainment achieved was a primary degree or above and zero otherwise; age as a count for the number of years old the person was – as well as age squared to allow for non-linear relationships in age; gender as 1 if male and zero otherwise; marital status as 1 if the person was married or living as such and zero otherwise; and smoking status as 1 if the person was a smoker and zero otherwise. These were regressed on healthcare use to estimate the change in the probability of use associated with being hearing impaired as opposed to not hearing impaired while controlling for these other variables. The additional probability was then combined with data on the frequency of service use where possible from the same surveys to estimate the number of additional visits. For example, if the probability of a hearing impaired person visiting the GP in the past 12 months was 0.6 (other variables controlled for), while that of a non-

hearing impaired person was 0.3, the additional probability associated with hearing loss was 0.3. If a typical person visited the GP four times in the past year, we would expect a hearing impaired person to have 1.2 more visits to the GP per year (0.3×4) than their non-hearing impaired counterpart.

Services examined were use of GP, inpatient, health visitor, home help, meals on wheels, social worker, chiropody, psychotherapy, speech therapy, physiotherapy, alternative medicine and 'other' services over the course of a year. The additional costs associated with hearing-related service provision were only calculated (monetized) for those services where there existed a statistically significant difference in the probability of their use among those who were hearing impaired and those who were not.

Additional service use was monetized using the 2014 Personal Social Services Research Unit (PSSRU) unit costs data to ensure a common pricing over the two time periods. With respect to GP services this was based on consultations assumed to last 11.7 and 17.2 minutes in duration including direct care staff costs and qualification costs. For social workers, the figure used related to those working with adults and are expressed on the basis of per hour of client-related work. Having estimated costs in 1992, the exercise was repeated for 2009.

The difference in the cost of service between the two time periods, expressed in the common years cost of 2014, provides an estimate of how much a hearing impaired person from 1992 would cost in terms of services used compared to 2009 in today's prices.

Results

In 1992 approximately 8.7% of the sample surveyed reported having impaired hearing; this compares with 10.1% in 2009. These figures are slightly less than recent estimates of the prevalence of hearing loss in Britain (Akeroyd *et al.*, 2014). Here using a definition of hearing impairment of 35 dB HL or more in the better ear (averaged over 500, 1000, 2000, 4000 Hz), 3.8 million persons aged 18–80 (8.3% of the population) were estimated to have a hearing impairment and 7.5 million (17%) if a 25 dB HL loss in the better ear is used to define hearing impairment. The authors acknowledge uncertainty around these estimates as well as the need to factor in those aged over 80 which would add approximately 2 million more persons to their estimate.

The increase in the prevalence found in the survey mirrors that reported in the literature (Akeroyd *et al.*, 2014) of roughly 12% – the estimate here being approximately 15%. The mean age of those reporting being hearing impaired in 1992 was 63.12. Seventeen years later the mean age was 67.10

indicating that the onset of self-reported hearing impairment appears to have been delayed somewhat overtime.

Service usage and costs

Regression analyses where significant differences in service use between those with hearing impairment and those without were in respect of GP and social worker services. (Full results available from the authors on request.) The monetization of estimated additional use is presented in Table 1.

In comparison to 2009, individuals with a hearing impairment in 1992 had a higher incremental use of GP and social worker services. Reference costs for GP consultations in the UK are based on consultations of two lengths, 11.7 minutes and 17.2 minutes. The additional cost per person per year associated with hearing impairment related to a GP 11.7 minute consultation in 1992 was £12.47 compared to £7.44 in 2009, a difference of £5.03 per person per year. For a 17.2 minute consultation, the costs were £18.16 in 1992 and £10.84 in 2009, a difference of £7.32 per person per year.

In respect of social workers, average consultation lengths are not reported in the references used for unit costs and instead a cost per hour of client services is reported. Assuming on average 3 hours of client services per year¹ in 1992, the additional cost per person associated with hearing impairment was £3.15 compared to those without an impairment. In 2009, no difference in use between those with and without a hearing impairment was found. The difference in costs between 1992 and 2009 is therefore estimated at £3.15 per person per year. Assuming one social worker consultation per annum, the average annual difference in cost is £1.05.

If we assume the number of persons with a hearing impairment in 2009 was approximately 10 million (7.5 million with an average hearing loss of at least 25 dB HL in the better ear (averaged over 500, 1000, 2000, 4000 Hz) aged under 80 and approximately 2.5 million aged over 80) and in 1992 approximately 12% less than this, this translates to a prevalence in 1992 of 8.8 millions. Multiplying this increase in the hearing impaired population between 1992 and 2009 by the combined reduction in GP and social worker costs between 1992 and 2009 (£5.03 + £1.05 = £6.03) translates into an annual reduction in costs of £53.50 millions in 2009 based on 11.7 minute GP consultations and one social worker consultation. Assuming 17.2 minute consultations and three social

¹In the absence of other estimates of social worker contact time we choose 3 hours based on the average number of contacts reported among social workers working with disabled children over a two year period annualised, 6.5 rounded to 6 (Glendinning, 1986) and NICE guidance on the minimum duration of a home visit of 30 minutes (NICE, 2015). It is acknowledged our estimates are based on disparate sources and should be treated with caution as a result.

Table 1 Cost of services at 2014 price levels

Service	Duration of consultation/frequency of contact	Additional cost* per person per year (£) 1992	Additional cost* per person per year (£) 1992	Difference in cost (£) of hearing impairment per person per year (1992 vs. 2009)
GP	11.7 minutes	12.47	7.44	5.03
GP	17.2 minutes	18.16	10.84	7.32
Social worker	Three visits per year	3.15	0	3.15
Social worker	One visit per year	1.05	0	1.05

*Compared to non-hearing impaired.

worker visits per year the comparable figure is a reduction of £92.14 millions per annum.

Discussion

The analysis demonstrates a reduction in the use of GP and social worker services by those with a self-reported hearing impairment relative to those with no such impairment over the period 1992–2009. The reduction in use of GP and social worker services are in the order of £53 to £92 million per annum in terms of financial costs. These are ‘savings’ in the sense that they represent a reduction in the cost of service delivery that would otherwise have had to have been met had those in 2009 exhibited the same patterns of service use as those in 1992. That this reduction coincided with increased access to cochlear implants (Raine, 2013) and to the provision of digital hearing aids by the NHS may suggest increased access to these technologies changed the pattern of need among those with hearing impairment, reducing isolation that may have resulted in additional visits for other conditions such as depression. It is recognized that there were other changes during this period; for example, changes in communication technologies such as texting, email and assistive devices which may have changed behaviors but the most striking change is that of access to hearing technology. In as much as cochlear implants and digital hearing aids were ostensibly unavailable in the UK in 1992, it may be reasonable to suggest that increased access to these over time played a role in reducing the estimated burden of hearing impairment noted here, in spite of the other changes during this time. That is, increased access to such technologies may have reduced the needs of those with hearing impairment in terms of other aspects of health and social care and affected savings for the health service as a result.

The study serves to highlight the importance of factoring into analyses of the impact expanded candidature for cochlear implants the broader economic burden of the condition. If, when considering expanding access to implantation, we look solely at the impact on budgets of implantation, habilitation and maintenance, we miss the changes in costs that can arise elsewhere and may misallocate resources as a result. The exercise also throws into sharp focus the challenges

that arise in estimating the impact of expanded candidature on the economic burden of hearing impairment.

There are various limitations to this study. These include the exclusion of productivity losses and of outpatient services where additional savings may well exist. Importantly, we have not included the monetary value of health-related quality of life for users which would be reflected in quality adjusted life year (QALY) gains in economic evaluations. Others have noted the substantial contribution of productivity losses associated with hearing impairment in Britain using other methodologies, and a 2013 estimate put those losses in the region of £25 billion (Hearing Loss Commission, 2014).

Our assumption that the reduction in need may be attributable to greater access to new technologies is of course also open to question. Over time, hearing impaired individuals may have become healthier for reasons unrelated to new technologies, due to better housing, diet, greater access to other technologies in work and the home. While we have attempted to control for health and changes in health through an extensive list of covariates it may remain the case the individuals were healthier in 2009 than 1992 though why this should benefit those with hearing impairment to a greater extent than others in the population seems unclear.

Expanding the criteria for candidature for implantation for adults brings with it difficulties in terms of the quantification of the number of candidates. The current criteria (NICE, 2009) are 90 dB HL at 2 and 4 kHz, and the current debate is about expanding these to 80 dB HL pure-tone audiometric thresholds at 2 and 4 kHz levels (Lovett *et al.*, 2015). The difference in demand should the criteria be expanded is not clear – not everyone with hearing loss at this level may be suitable for implantation and among those who are, not all may wish for a variety of reasons to receive an implant. However, since only 5% of those currently suitable are receiving implants (Raine, 2013), should the criteria be expanded, there will be potentially even larger numbers of patients who are suitable audiolgically for implantation. The current study suggests that future analyses of the impact of candidacy changes should not only consider the potential

for increased demand on budgets related to the provision of hearing services but also the impact on other services such as GP and social services where there may be associated reductions in cost.

Conclusion

We estimate the savings arising from reduced use of health and social care among those with a hearing impairment between 1992 and 2009 to be in the order of £53 to £92 million per annum. These arose as access to new technologies for managing hearing impairment increased and it is reasonable to assume that they can be at least partially attributed to the reductions in need that access to such technologies permitted. While the exact level of savings may be open to debate given the limitations of our study, we have demonstrated the need to factor broader savings into decision making. In respect of expanded candidature to cochlear implantation, similar savings may be realizable. Discussions of expanding the criteria for cochlear implantation should therefore consider the potential savings to the health and social care budgets as a whole, rather than focus solely on the increased costs of providing the technology more widely.

Disclaimer statements

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Conflicts of interest None.

Ethics approval None.

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