Costs of screening programmes (*)

PJ Govaerts

University Department Otolaryngology, St.-Augustinus Hospital, Antwerp-Wilrijk (Belgium)

The European Consensus Statement on Neonatal Hearing Screening.
Grandori F, Lutman M (Eds.). Milan 1998.

Project AHEAD - Advancement of Hearing Assessment Methods and Devices.
European Commission, Directorate-General XII, Biomedicine and Health Programme.

(*) This is not a peer-reviewed scientific paper, but one of the sixteen contributions to the final report for the European Community Project AHEAD.

The report is based on original data and data from Davis 1997, Maxon 1995, Mehl 1998, Turner 1991, Turner 1992, and Weirather YP 1997.

INTRODUCTION

Things of value have a price. Modern medicine is reaching the upper plateau-phase of the sigmoidal cost-benefit curve, which means that the cost to obtain any further improvement in the health situation of our society is becoming very high. Society as well as its political representatives should be aware that no increase in health is to be expected without due investment.

Clearly the decision as to which benefit justifies which cost is a political one. The task of the medical world is primarily to demonstrate the benefit of a given intervention in terms of health parameters. For this the medical world has conceived strict scientific rules that are widely accepted. A new task that is demanded from clinicians is to calculate the cost of any new intervention. This is about to introduce a revolution in our way of thinking. In addition to expressing our outcomes in terms of health parameters, we are now forced to do so in terms of financial parameters as well. And it is only natural that we feel uncomfortable in doing so, not only because we lack the competence and proper instruments but also because we dislike the idea of health being of secondary importance when compared to money.

Already now, ample evidence exists to state that the direct cost of neonatal hearing screening is known, that neonatal hearing screening can be one of the cheapest screenings, and that the cost is justifiable and relatively low when compared to other screening programs for congenital diseases.

COST ANALYSIS

Costs can be categorized in many ways, such as health costs, individual costs, family costs and social costs. The topic here is primarily health costs.

Health costs can be calculated following two major approaches: the bottom-up model and the top-down model.

The bottom-up approach collects data on all subcomponents for a specific service. This approach yields rigorous data, but it takes a lot of time and an obsessive sense for detail to scrutinize all aspects of the service involved. The top-down approach collects aggregated data on costs and estimates individual costs for particular services. This approach is easier and cheaper than the bottom-up approach, but the data are inferred from group data and thus less rigorous.

In defining the health costs of a service like hearing screening, it is essential to identify all the program elements and to estimate the costs of each ingredient accurately. This requires a complete description of the program and its components. Researchers should be most careful in estimating the costs of equipment and supplies, personnel, including screeners, clerical staff, coordinator and audiologists, fringe benefits and overhead. It is equally important not to underestimate the cost of resources. An appropriate measure of a resource's cost is its best alternative value. This means that if a program uses a room free of charge, but the room would otherwise be used by someone else, then there is a so called "opportunity cost" even if the program does not pay for it. A similar "opportunity cost" must be accounted for in case the screening program uses resources that are included in another program's budget. Calculating the cost of a screening program should also cover all stages that precede referral to a diagnostic centre such as the initial screen, the rescreen, the scheduling, tracking and referral procedure.

Factors that influence the cost of hearing screening

Good cost-analyses are available and the main sources of information are from the USA and the UK.

The issue of cost relates to the type of screening strategy. Basically the choice can be made between neonatal versus screening at 9 months of age; between targeted screening versus universal screening and between maternity-unit based versus home based programs.

Three cost parameters are commonly used and will also be used here.

(1) The **"cost per child tested"** covers the cost of the screen and rescreen and is a measure of how much should be **charged** for screening a child.

(2) The "**cost per 1000 births**" is a measure of what it **costs to implement** the program and reflects what politicians or health economists are most interested in and

(3) The "**cost per child detected**" is a measure of **cost-effectiveness** and is therefore interesting to compare screening programs for two different health problems.

The cost of a screening program depends on several factors. I will try to summarize them in three categories:

(1) Epidemiological factors, mainly the prevalence

(2) Test-specific factors

(3) Protocol specific factors.

The prevalence obviously does not influence the implementation cost of a program (Figure 1). The screening has a certain cost and this does not change whether children are being detected or not.

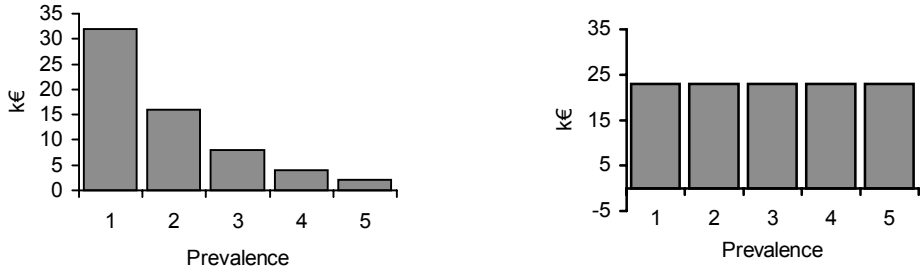

FIGURE 1. Influence of the prevalence (expressed as cases per thousand births) on the implementation cost (left: cost per 1000 births) and on the cost-effectiveness (right: cost per child detected)

In contrast the prevalence does have a significant influence on the cost-effectiveness (Figure 1). The higher the prevalence, the lower the cost per child detected. For instance in the case of neonatal hearing screening, a prevalence of 1.2 per 1000 makes a cost of approximately 25 k€ per child detected, whereas a prevalence of 3 per 1000 reduces this to approximately 10 k€.

Test-specific factors that influence the cost of a program are related to equipment and supplies, to personnel and to the site of testing. As an example of the impact of equipment and supplies, I have taken some rough figures to compare TEOAE and AABR: the equipment costs 8000 € and 10000 €, respectively; for TEOAE the supply costs are approximately 1 € per child for disposable probe tips and probe replacement compared to 8 € for AABR to cover disposable earphones and electrodes. As it will be discussed below, this difference accounts for a 40 % higher cost per child screened with AABR instead of with OAE.

It has been calculated that personnel costs represent some 70 % of the total costs and this is important because personnel costs differ substantially between different countries.

It is self-evident that maternity-based screening is far less expensive than home based screening, but to the best of my knowledge, no published data are available to quantify this difference.

Then there are protocol-specific factors that influence the cost of a program.

A targeted program aims at testing 6 to 10 % of all infants. This is far less than a universal program, aiming at some 95 %. Consequently, even if the cost of an individual "targeted" screen is higher than that of an individual "universal" screen, the total cost of a targeted program may still be substantially less than of a universal program. As we shall see later, the only problem with targeted screening is the good definition of a target.

Is a unilateral "pass" considered a pass or a fail? If it is considered a fail, we must be prepared to screen some 10 % additional children. This means that, although the impact of a unilateral hearing loss is much less than the one of a bilateral loss and although possibly no "early" intervention is needed for a unilateral loss, the cost for finding it is almost the same as for finding a bilateral loss. We must ask ourselves whether the cost-benefit for such a child with unilateral hearing loss is still positive.

The referral algorithm will also influence the total cost. The cost of a diagnostic work-up is usually much higher (factor 5-10) than the cost of a re-screen. Reducing the referral rate by re-screening some 3 weeks after the initial fail will reduce the total cost.

If the referral rate can be kept lower than 1 %, the impact of the diagnostic work-up on the total cost will be minimal (Figure 2). But if the referral rate gets higher, the impact of the diagnostic work-up will become substantial.

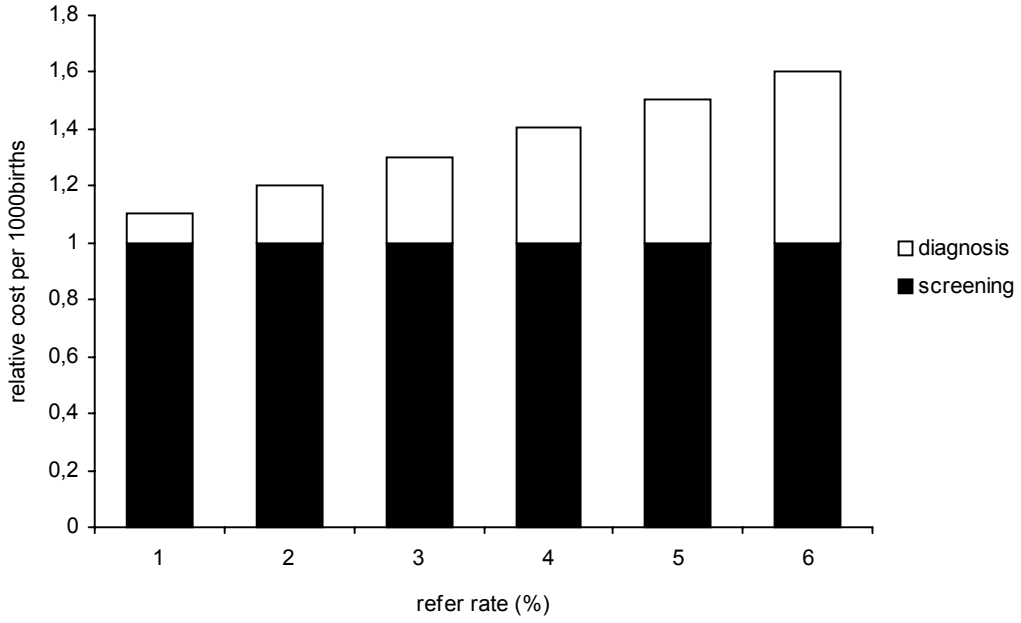

FIGURE 2. Effect of refer rate on the implementation cost of a screening program.

Another cost-determining factor is the number of patients that are "lost to follow-up". This does not significantly influence the total cost, but the cost-effectiveness will be negatively influenced, mainly because the prevalence of hearing loss in these children is obviously much higher than in the whole group. Loosing children during the re-screen-process is not as dramatic as loosing them during the referral procedure. But even in the re-screen-procedure, the number of children that does not show up any more should not exceed 10 %. During the referral procedure, loosing as few as 3 children per 1000 increases dramatically the cost per child detected. It is therefore of crucial importance to invest a good deal of money in tracking these children.

Cost of hearing screening

Published reports show different cost-data. This can be explained by the factors previously described. A comprehensive summary of different screening programmes in their most typical form is given here.

The distraction test has been the standard so far. The child is tested at the age of approximately 9 months by typically two trained testers. The cost per 1000 births is about 20 to 40 k€, provided that 90 % of infants are tested. This coverage is certainly not reached in all regions of Europe. There is a low yield, partly because by the age of 6 to 9 months several hearing impaired children have already been referred through targeted neonatal screening programs or professional or parental concern. The test is also characterised by a low sensitivity and

specificity. The low yield results in a bad cost-effectiveness. It costs approximately 130 k€ to detect a single hearing impaired child. In addition the detection is relatively late thus producing extra long-term costs. The targeted neonatal screening that often precedes the distraction test has not even been considered in this cost analysis.

The cost of this type of screening is clearly high. In an attempt to reduce these costs, the Joint Committee on Infant Hearing has published a list of "risk factors" or as they are now called "indicators of hearing loss" that aim at reducing the number of children to be screened. Children with one of these indicators are typically tested by ABR. This is an expensive test, but since only some 8 % of children have to be tested, the implementation cost is rather low (8 k€ per 1000 newborns) and the cost-effectiveness is good (18 k€ per child detected). It should be stressed here that only 50 % of hearing impaired children fall into at least one of these risk categories and that consequently only half of the hearing impaired children can be detected by a targeted screening.

The implementation cost of a universal neonatal screening program is approximately 20 k€ in case of an OAE-based screening and 28 k€ in case of an AABR-based screening. The cost-effectiveness equals that of the targeted screening. Again it is important to note that approximately 95 % of hearing impaired children are detected by universal screen and that these children are detected at a very early stage, offering quite a few additional advantages.

TABLE 1. Overview of cost data (expressed in €; k= x1000 €).

	Distraction test	Targeted Neonatal	Universal Neonatal (OAE)	Universal Neonatal (AABR)
Cost per child tested	37	109	18	25
Cost per 1000 births	30k	8k	20k	8k
Cost per child detected	135k	18k	7-25k	9-35k

Clearly the most cost-effective programs are neonatal programs, both targeted and universal. The implementation of a targeted program is definitely cheaper than a universal screening program, but as has already been said, in a targeted program 50 % of hearing impaired children remain undetected.

When we compare the cost of a universal neonatal program to other operational screening programs for congenital anomalies such as hypothyroidism, phenylketonuria (PKU), cystic fibrosis and sickle cell anaemia, screening for hearing loss appears to be more expensive as such, but the cost-effectiveness is amongst the best, due to the high prevalence of sensorineural hearing loss.

TABLE 2. Comparative data of different screening programmes

	SNHL	Hypo-thyroid	PKU	Cystic Fibrosis	Sickle cell anaemia
Prevalence / 100.000	240	23	6	45	12
Cost per screen (€)	23	3	3	3	3
Cost per child detected (€)	9000	10000	37000	5500	21000

SNHL: sensorineural hearing loss; PKU: phenylketonuria

A net balance of costs and savings is hard to make, but in an attempt to do so, costs consist of the actual screening costs, the costs of follow-up and confirmatory evaluation and the cost of

early intervention; and savings consist of averting costs of late diagnostic tests, of rehabilitation and of pre-school and school-age educational programs. In an estimate as close to reality as possible, net savings occur only 10 years after implementation of a neonatal screening program.

In conclusion, one must realize that the cheapest option is not to screen at all. Screening infants is a commitment based on definite medical, cultural and ethical arguments. It takes a lot of money to do so, but it also takes quite a good deal of money not to screen. If Society decides to screen, neonatal programs are by far the most cost-effective and as such even cheap in comparison with other operational screening programs for congenital diseases. The implementation cost of a targeted program is less than of a universal program, but a targeted program is bound to detect at most 50 % of hearing impaired children, compared to approximately 90-95 % detected by a universal program. Not identifying half of the children also implies a great cost, not only in medical and human terms, but also in economical terms, because of the additional costs of late detection and because of the need to have another program running to catch this remaining half at a later stage.

Thus, universal, neonatal, maternity-based hearing screening is the only program that can identify approximately 90-95 % of the hearing impaired children at an early stage and at a cost of about 20 k€ per 1000 newborns. Community can count on net savings only 10 years after the implementation of such a program.