Evaluation of Cost-Effectiveness of Cochlear Implant Use in Albania and Benefits from its Applications to Children with Profound Loss Hearing

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Abstract

Background: It is estimated that each year in Albania, about 70 children are born with profound hearing loss. If detected and diagnosed early (before age 4-5) and treated with cochlear implant, these children are likely to recover from the loss of hearing in a certain extent and to gradually develop speech, thus integrate in life and society.

The purpose of this study is to compare these two alternatives by combining the costs and respective benefits or outcomes through a pharmacy economic evaluation. This assessment provides theoretical data on the problem of profound hearing loss mainly in children, long-term consequences of this condition in their life mainly in lingual development , cognitive (cognitive), emotional, and social benefits and highlights the impact of cochlear implant in the lives of these individuals.

Methodology: As for those individuals, whose quality of life is compromised by their defect, we used a cost-utility analysis. The assessment is done from the perspective of the payer and the society. After assessment of costs and calculation of QALYs for each alternative we concluded.

Conclusions: Cochlear implant improves hearing perception and helps the development of speech at young children with profound hearing loss under the age of 4-5.The younger the child is the greater are the benefits. Cochlear

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implant is more cost-effective from both perspectives considered by our study (Payer and Society) compared with no implant.

Key Words: Cochlear Implant, Deafness, Cost-Effectiveness, Life Quality, Lost Hearing.

1. Introduction

The purpose of this study is to assess the cost-effectiveness of cochlear implant in our country. This assessment provides theoretical data on the problem of profound hearing loss mainly in children, long-term consequences of this situation on the quality of their lives primarily in developing the lingual, cognitive, emotional, and social abilities and highlights long-term benefits of cochlear implant combining implant economic cost to income in the lives of these individuals. Rating is done from the perspective of the payer and the society.

2. Data from the Literature

2.1. Description of the problem

Hearing loss is a common problem that increases with age (Copeland and Pillsbury, 2004). Approximately 40% of people aged over 50 have varying degrees of deafness (Davis and Bamford, 1997).

A person who can hear sounds on 20decibel level (dB) is considered of normal hearing. People with severe hearing loss (serious) cannot detect tones below 70-94dB, but people with profound hearing loss cannot detect tones below 95dB. Traditional acoustic aid can improve the function of the hearing but is not effective for people with profound loss of hearing (Fortnum and Marshall, 2002). For this group of people, cochlear implant has proved to be an effective alternative treatment (Fortnum and Summerfield, 2001).

2.2. Epidemiological data

The incidence and prevalence (children 0-16 years)

The prevalence of children with severe loss to the deep sensor neural hearing is about 50 cases per 100,000 children (Herbst and Humphrey, 1981). About 1 in 1000 children aged 3 is profoundly deaf. 2 in 1000

children are profoundly deaf in children aged 9-16 (Owens and Espeso, 2006).

2.3. Etiology in children

It is estimated that etiology of serious hearing loss is likely to be 22% or more of prenatal origin compared to other levels of deafness (Royal National Institute for the Deaf 2006). Those with profound hearing loss are more likely to have genetic origin (42%), postnatal (20%) prenatal (12%) (Sallavaci, 2009). From a study that evaluated children with a cochlear implant, most of them had postnatal etiology 47% (Sallavaci, 2007).

2.4. Pathology

The hearing disorders can be classified as conductive or neural sensor. Conductive deafness is caused by the injury of middle or external ear, which prevents the sounds transmission at the cochlear. The nuclear implant is not a treatment for the conductive loss of hearing.

The sensor neural loss of hearing happens when there is an injury of the inner ear or the pathof the nerve from the inner ear to the brain. The sensor neural loss of the hearing is permanent and includes not only the reduction of the hearing skills, but alsoaffects the language understanding and speaking development.

The sensor neural loss of hearing can be caused by diseases, injuries during birth, medicaments which are toxic for the hearing apparatus and the genetic syndrome. It can also be caused by the noise exposure, viruses, head traumas, age and tumours. The sensor neural loss of hearing is heavier than the conductive one by causing absence of the sounds sensitivity, even of the very strong sounds.

2.5. The hearing loss impact on kids.

In kids, the hearing loss has important consequences on lingual development, recognition, emotional and social abilities (Weinstein, 1989). Many deaf kids live isolated during first years of their lives, until they start being in touch with the other deaf kids in school.

Their early live is dominated by the efforts to adapt with their disorder. This includes attempts to read lip movements, to learn sign language in isolation or in special schools. Inability to express their desires or needs can isolate them from other members of the family.

In school these children may exhibit more behaviour problems than their normal peers. Children with congenital profound loss of hearing do not perform well at school, and do not develop academic skills. In the long term, children with loss or uncorrected hearing loss are at risk of becoming unemployed.

Ratings of quality of life in young children (under 5) are classified by parents or teachers. It is estimated that 95 of deaf children have both parents with hearing, and 95% of these children have at least one parent with normal hearing (Sangster, Gerace; Can Med Asocc J. 1991). There is no standard measurement of the life quality for these children, teenagers or their parents, but in general several methods are used.

Children health Questionnaire (CHQ-Child Health Questionnaire), the Munich questionnaire of Life Quality Child (KINDLr), Health utility index (HUI). These methods are used to assess the quality of life for patients with severe loss to profound deafness in children with pre-lingual hearing including using acoustic hearing aid or cochlear implant. Pre-lingual deafness is when deafness occurs before a child develops speech. In this case the age of three is taken as reference. Post lingual deafness refers to deafness occurring after this time.

In adults, deafness can affect their quality of life and family. Some studies have reported that 82% of deaf elderly have experienced a side effect on the quality of their life and 24% were depressed (Sataloff, 1996). Difficulties commonly reported by the deaf post-lingual adults include feelings of isolation, lack of confidence and tinnitus. These difficulties lead to withdrawal from intellectual activity, cultural stimulation and cognitive functions.

2.6. Quality of life with a family member with hearing loss

Since most of the parents and relatives of a deaf person did not have previous experiences with deafness, must spend considerable time and effort to manage communication problems or to help their deaf member in social activities etc.. Over time, this additional load may result in a deterioration of physical health, decrease of emotional level and psychological stress. Their magnitude depends on the person, severity of disorder.

2.7. The significance for the health system

Although hearing loss or deafness is not a disease, it is a condition that requires medical care and that has an impact on the health system resources necessary for diagnosis, evaluation and award of traditional acoustic aid or cochlear implant.

Cochlear implant has been available in Europe since the 1980s and since then, implant and coding sounds strategy has been improved by its use. Cochlear implant is already improved technologically and physically and is able to encode and to transmit all the speech, reaching 90% of the understanding of words and sentences (Copeland, Pillsbury; 2004).

2.8. The aim of the cochlear implant and the benefits it brings

The aim of the cochlear implant is to improve the quality of life by allowing individuals with hearing problems to hear and interpret sounds, improving their ability to understand others, communicate effectively and to feel safe in their environment, ultimately integrated into normal life. It is believed that in addition to people with profound hearing loss, from the cochlear implant may also benefit 25% of people with severe hearing loss (>85dB). In a summary, the income from cochlear implant includes:

1. Feeling of sounds
2. Perception of language
3. Production and development of language
4. Psychological Income
5. Educational Income
6. Adverse effects of the intervention (cholesteatoma, facial nerve injury, ear drum injury, infection, meningitis, implant abandonment in very rare cases (0.12%)
7. Improved quality of life
8. Social integration

2.9. Costs associated with cochlear implant

Costs associated with cochlear implant consist in:

1. Diagnostics and Assessment of profitably
2. Cochlear implant
3. Implantation procedure (surgery)
4. Tracking

3. Assessment of cost-usefulness cochlear implant - Current situation of children with profound hearing loss in Albania

3.1. Assessment of costs

It is estimated that each year in our country about 70 children are born with profound hearing loss. If detected and diagnosed early (before age 4-5) and treated with a cochlear implant, these children are likely to recover from the loss of hearing in a certain extent and develop speech gradually, thus integrate in life and society. If detected later and left untreated after the age of 5 years old, they lose the opportunity to develop the speaking and to communicate through language normally. This study compares these alternatives by combining the costs and benefits or income respectively. As for those individuals, whose quality of life is compromised by their defect, we will use a pharmacy economic analysis, of cost-utility type.

Respectively for the two alternatives in the study we will assess:

1. The costs and the benefits or income (unit for the assessment of quality of life)
2. QALY (quality of life adapted Years of Quality-Adjusted Life Year) gained from implantation
3. Calculating the additional cost report / additional income (ICER) if necessary

3.2. Costs/person- Option I (children with profound hearing loss are not treated)

Payer Perspective: These children up to age 6-7 are kept isolated in their family and supported by the social insurance system with a minimal contribution to the category of persons with disabilities by 9000 ALL per month (108 000 ALL per year). At the age of 6-7, these children have the opportunity to attend the 9-year education for this category at the National Institute for Deaf People .Operating Budget of the Institute for 2013 was 62500000 ALL and the total number of children who are educated in this institute is 90. So the state in average contributes an estimated 694444 ALL. After completion of education, they are still supported by the state with a minimum contribution of 9000 ALL per month as people with disabilities. If you appreciate the direct costs expended by the Government for support

of these individuals and taken for assessment base for average life expectancy of people in Albania of 72 years (Census 2012), will have the following:

Table 1: Total cost of deaf individuals from the perspective of the payer (the state)

Life stage (age) (Description)	**Expenses in a year (ALL)**	**Year (Nr.)**	**Total (ALL)**
Early Childhood (0-7vjet)	108,000	7	756,000
9-year education	694,444	9	6,249,996
The rest of life	108,000	56	6,048,000
Total (ALL)			13,053,996
Total (EURO)			**93,243**

Source: INSTAT, 2012.

According to the assessments below, the Albanian state spends about 93,000 euro to help the individuals who are born with profound hearing problems, while these individuals are not only a state burden but family and society burden too.

Society Perspective: If you appreciate the perspective of social costs, then these costs would still be raised because the cost to the state spends and will be added and other indirect costs of people who should care at all times for these people disabled and you do not go to work, or do business with limited time, indirect costs (the missing income) that these individuals would give the company if they would be able to work. Mentioning the average salary for Albanian citizens of 300 Euros per month or 3600 Euro per year (Albanian Statement Art.; 2012) then the cost of supporting the individuals with disabilities from the perspective of society would result as follows:

Table 2: Total cost of deaf individuals from the perspective of society

Cost (description	Years	Euro in year	Total EURO
Direct costs for disability assistance from the state	All lifetime		93, 243
Missing income from relatives to care for deaf people	40*	1, 800	72, 000
Missing income due to the inability of deaf persons	39.5**	3, 600	142, 200
		Total	307, 443

Source: INSTAT, 2012.

Note: *It is assumed that a relative takes care part-time for a deaf family member for 40 years.-

** It is assumed that if a deaf person is capable of work will begin to work after age 23 until 62.5 years of age (that is, the average age of retirement is 60 years for women and 65 years for men)

According to the perspective of society, cost for people with profound hearing loss is about 300, 000 Euro.

Rating Cost/individuals–Alternative II (children with profound hearing loss who are treated with cochlear implant)

3.3. Calculating the total cost of cochlear implant

Assessment of benefits/income from Alternatives I (children with profound hearing loss who are not treated) and Alternatives II (children with profound hearing loss who are treated with cochlear implant)

Table 3: Calculating the total cost of cochlear implant

Description	**Total Cost (EURO**
Diagnosis and Assessment of eligibility	20,000
Cochlear Implant	
The implantation procedure (surgery)	
Tracking	

Source: Nurotron Bio-Technology Co., Ltd File.

Because in our country there are no studies assessing the quality of life of children with profound hearing loss, usefulness of this alternatives will extrapolate from studies of literature. The study by Barton and colleagues in UK gives relevant assessing of the weight of the utility of children with profound hearing loss before and after the implant. The results of this study are as follows:

Table 4: Summary of utility values used in the PenTAG analysis

Group Implanted	Utility without cochlear implant	Years since implant	Estimated utility gain, unilateral (95% CI)	Estimated utility gain, bilateral (95% CI)	Source
Profoundly deaf prelingualy deafened children	0.421	NA			Weighted mean of data relating to profound and 'group profound' in Barton 2006
		< 2 years	0.066 (-0.013 to 0.144)		`Data relating to those implanted at < 5 years of age in Barton 2006
		≥ 2 and < 4 years	0.212 (0.161-0.263)		
		≥ 4 years	0.232 (0.194-1.280)		
		NA		0.03 (-0.045 to 0.104) (versus unilateral)	Authors assumption
Profoundly deaf postlingualy deafened adults	0.433	NA			Data relating to all 311 implanted adults in UKCISG 2004
		NA		0.03 (-0.045 to 0.104) (Versus unilateral)	Summerfield 2006

Source: Barton and colleagues 2006, Author assumption, UKCISG 2004, Summerfield 2006.

3.4. The results of this study

As estimated by the authors, the usefulness of the first alternatives I is 0.421 HUI (Health Index usefulness).

In our country the number of people (mostly children) who have undergone a cochlear implant to overcome their disability is small (15 individuals), it is impossible to extract a single significant result on income and benefits that has brought the implant in quality to their lives. For this reason one can extrapolate on our population results from other studies from the perspective of designing reliable study, statistical data, and similar perspectives and evaluated by certified competent authorities. From the above mentioned study it is evaluated the long-term usefulness of the authors 0 .653 in HUI, with an increase (profit) of 0.232 in HUI

Assuming that the cochlear implant or the lack of the hearing depth does not affect the lifespan of these individuals, for further evaluations we will take the average life expectancy of 72 years.

Below are two alternatives income from the study expressed in QALY:

Table 5: Incomes in terms of QALY from both alternatives

Alternatives	Years of life	Utility weight (HUI)	Income (QALY)	QALY obtained by alternalives II
Alternatives I	70	0,421	29,47	-
Alternatives II	70	0,653	45,71	16,24

Source: Authors' own calculation

It is assumed that the implant is obtained at the age of one and weight of usefulness is constant over the years of life

To interpret the results of the above, we should start from the meaning of the proceeds of this method "QALY". Individuals who are subject of alternatives I, although they can live up to the age of 72 as the population average but with profound hearing deficiency, it would be like for them if they lived only 32 (2 +30) years without their problem. For individuals who

would be subject of cochlear implant, although they can live up to 72 years will be the same for them as if they live up to 48 years (2 +46) as normal individuals.

If we combine the costs by cost-effectiveness mapping and revenues from the two alternatives studied, we will see that the second option has higher revenues and lower costs, it is cost-effective.

Table 6: Map of the cost effectiveness

cost effectiveness	lower cost	the same cost	higher costs
lower effectiveness	A calculate ICER	B	C Dominant
The same effectiveness	D	E	F
The highest effectiveness	G Dominant	H	I Calculate ICER

Source: Authors' own calculation.

According to the perspective of the payer (State) by the application of alternative II (cochlear implant) for an individual with profound hearing loss a certain amount of money will be saved;ie.

Cost Alternative II - The Cost Alternative I = 93243 - 20000 = 73243 euro over the life of the individual

According to the perspective of society by the application of alternative II (cochlear implant) for an individual with profound hearing loss, a certain amount of money will be saved; ie.

Cost Alternative II - The Cost Alternative I = 307443-20000 = 287,443 euro over the life of the individual.

4. Conclusions

1. Cochlear implant improves hearing, language perception and its development in young children below the age of 4-5 with profound hearing loss. The benefits are greater the younger the child is.

2. Cochlear implant improves the quality of life, income from their academic education and integration into society
3. Cochlear implant is more cost-effective from both perspectives in the study received (Payer and Society)
4. According to the perspective of the payer (State) by the application of alternative II (cochlear implant) for an individual with profound hearing loss, 73,243 Euros will be saved over the life of the individual
5. According to the perspective of society by the application of alternative II (cochlear implant) for an individual with profound hearing loss 287,443 Euros will be saved over the life of the individual

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