ECONOMIC ANALYSIS IN DENTISTRY

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ABSTRACT:

Economic evaluation of healthcare programmes is an important part of dental care management in public and private dentistry. An economic evaluation in dentistry has at least two parts: first, the goal is to choose a less costly procedure and the second aspect refers to the possibility to choose a programme with high efficiency. For the political point of view, it is simple to accept a program with low costs and low efficiency, but from ethical point of view, the least expensive programme is not always equivalent to getting the expected benefits and patients are the first to suffer. This article reviews the various methods of economic evaluation and also gives examples of some of the current research in the field of dentistry.

Keywords*:* **economic evaluation, cost-effectiveness analysis, dentistry**

In the last years, there has been a focus on a real economic evaluation of the health systems, costs of medical care is increasing due to technological changes and increasing number of sick people [1]. In 2010, untreated dental caries in permanent teeth was the most prevalent condition worldwide, affecting 2.4 billion people, and untreated caries in deciduous teeth was the tenth most prevalent condition, affecting 621 million children worldwide [2].

Health economic evaluations provide decision makers important information regarding the cost-effectiveness of the different programmes

with different costs and benefits. Generally, all analyses search the opportunity cost of the programmes in relation to the additional effects and the treatments should be compared with the best alternatives [3].

Economic evaluation may be defined as 'the comparative analysis of alternative courses of action in terms of both their costs and consequences. Any economic analysis involves measurement of both the benefits of healthcare and also the costs [4]. Benefits may be divided into gains in health status (direct benefits) as well as other indirect benefits (eg production gains).

Various types of cost can be identified within the health care setting and can be categorized as *Direct costs* and *Indirect costs* [5].

1. ***Direct costs*** are divided in *medical costs* (health service cost related services) and *non-medical costs* incurred by patients and their families (inputs to treatment and expenses, social services). Direct costs are relating to the use of resources such as professional staff and consumables, the costs for patients: of routine equipment, drug, anesthesia, and consumables.
2. ***Indirect costs*** include costs incurred by patients and their families (loss of productivity), and costs borne by the rest of society [5,6] .Costs incurred by patients and their families include: out of pocket expenses for services; Items such as special foods and medication, which are not reimbursed to the patient, may be included in this category. Indirect costs refer to the number of unpaid days or hours taken off work, loss of income,

MAIN TYPES OF ECONOMIC ANALYSIS

Main types of economic analysis used in health care include the following:

- ***Cost-minimization analysis****:* a determination of the least costly among alternative interventions that are assumed to produce equivalent outcomes.

  The aim is usually to find the lowest cost programme and the unit of measurement is cost per intervention. In dentistry is used, for example, to compare the scaling procedure performed by dentists to the one performed by the dental hygienist: it has the same effect, but the wage costs are different.
- ***Cost-effectiveness analysis (CEA):*** a comparison of costs in monetary units with outcomes in quantitative non-monetary units (for example: reduced mortality or morbidity).

  This method is used when the programmes may have differential success in outcome, as well as differential costs, but the outcome

must be common to both programmes. For example, a comparison of several different materials for dental restorations, or the differences between sealant programme and amalgam restoration in children with the aim to find the most efficient treatment option in terms of cost per healthy tooth year gained.

The results of CEA are usually presented in the form of ratio.

Usually, a new programme is compared with current programme . The question is: *Witch treatment strategy is most economically effective*? The ratio is :

$$\mathbf{CE} = \frac{\text{Cost new programme} - \text{Cost old programme}}{\text{Effect new programme} - \text{Effect old programme}}$$

- ***Cost-utility analysis (CUA):*** a form of cost-effectiveness analysis that compares costs in monetary units with outcomes in terms of their utility, usually to the patient, measured in QALYs. Utility refers to the value or worth of a particular health state or an improvement in that health state. Utility values lie between 0 and 1, where 0 is equivalent to death and 1 is equivalent to perfect health. CUA should be the method of choice when quality of life is an important outcome.
- ***Cost-benefit analysis (CBA):*** compares costs and benefits, both of which are quantified in common monetary units. Since both costs and consequences are measured in monetary units, it is possible to calculate whether a treatment delivers an overall gain to society [5].

COST-EFFECTIVENESS ANALYSIS IN DENTISTRY

Cost-effectiveness analysis is a method for assessing the gains in health relative to the costs of different health interventions. It is not the only criterion for deciding how to allocate resources, but it is an important one, because it directly relates the financial and scientific implications of different interventions. The basic calculation involves dividing the cost of an intervention in monetary units by the expected health gain measured in natural units such as number of lives saved .

In 2005, Kitchens published a review in the literature regarding the cost-effectiveness of pit and fissure sealants as a preventive strategy in preventive dentistry [7]. Sealant application is a conservative preventive measure and is virtually 100% effective in protecting the tooth surface from the bacteria in the oral environment if it is fully retained on the tooth. In preventive dental programs cost effectiveness analysis is used to determine the cost to save one decayed, missing, or filled tooth or surface. The focus of the literature on the cost-effectiveness of pit and fissure sealants is primarily linked with school-based

sealant programs and children from low socioeconomic backgrounds.

Klein conducted the National Preventive Dentistry Demonstration Program in USA project between 1976 and 1981 to assess the cost and effectiveness of different types of schoolbased preventive programs in five fluoridate and five non-fluoridated communities with 20,052 first, second, and fifth graders. The treatment analysis focused on the number of decayed, missing, and filled permanent tooth surfaces between baseline and the end of the study 48 months later. Treatment costs were based on years two and three to eliminate biases of start-up or close-down costs. The sealant cost was $23 per child per year, which was more than the cost of treatment to restore the tooth $19.92 (in 1981 dollars). Fluoridation of community water supplies ranged from $0.06 to $0.80 cost per capita per year. This study showed sealants prevented decay by 23% to 65%, which translated to one or two carious lesions in four years [8].

Vogel in 2013 published an article with the aim to review the available literature on the costs and cost-effectiveness of dental implant-supported or -retained prostheses versus tooth-supported fixed partial denture restorations or mucosa-borne conventional complete or partial dentures. The conclusions of the 14 studies showed that for single-tooth replacement, a single implant was a cost-effective treatment option in comparison with a traditional three-unit fixed dental prosthesis. For the replacement of multiple teeth, dental implants (fixed or removable prostheses) were associated with higher initial costs but better improvements in oral health-related quality of life compared with other treatment options [9].

Pennington evaluated in 2009 the cost-effectiveness of root canal treatment for a maxillary incisor tooth with a pulp infection, in comparison with extraction and replacement with a bridge, denture or implant supported restoration. They concluded that modeling the available clinical and cost data indicates that, root canal treatment is highly cost-effective as a first line intervention. Orthograde re-treatment is also cost-effective, if a root treatment subsequently fails, but surgical re-treatment is not. Implants may have a role as a third line intervention if re-treatment fails [10].

A randomized clinical trial was done in 2013 by *Cristiane da Mata* in order to compare the cost-effectiveness of Atraumatic Restorative Treatment (ART) and a conventional technique (CR) for restoring carious lesions as part of a preventive and restorative programme for older adults [11].

In this randomized clinical trial, 82 patients with carious lesions were randomly allocated to receive either ART or conventional restorations (CR). For the ART group, the cost of care provided by a dentist was also compared to the cost of having a hygienist to provide treatment. Effectiveness was measured using percentage of restorations that survived after a year. The results showed that average cost for ART and conventional restorations was €16.86 and €28.71 respectively and the restoration survival percentages were 91.1% and 97.7%, respectively. This resulted in a cost-effectiveness ratio of 0.18 (ART) and 0.29 (CT). When the cost of a hygienist to provide ART was inserted in the analysis, the resulting ratio was 0.14. The authors concluded that ART was found to be a more cost-effective alternative to treat older adults after 1 year, compared to CR, especially in out of surgery facilities and using alternative workforce such as hygienists.

Murariu and *Hanganu* in 2011 conducted a study with the aim to make an economic analysis (cost-effectivenes) of two alternative dental programmes: programme 1: sealant programme for preventive dental caries and programme 2: amalgam restoration [12].

The study was performed in 2009-2010 and the sample included 68 children aged 7-8 years, 34 children (group A) received sealant and 34 children (group B) received amalgam restoration for incipient dental caries. The costs used in analysis were provided by the National Health Assurance for 2009. After 12 months the following aspects were appreciated:

- Retention of the sealant and amalgam restoration;
- The accidental complications;
- The direct costs of the procedures;
- The effectiveness of the used procedures evaluated as the number of sound teeth.

The results showed the statistically significant differences between the costs of the programmes: programme A is more expensive than programme B, but the effectiveness of the sealant program was higher with a higher number of caries free teeth. The authors concluded that, although the health policy is to choose minimal costs for medical services, the sealing programme should be introduced in children communities where there is a high risk for dental caries. An important aspect is the *time factor*, because it is well known that the results of preventive procedures don't appear immediately, so it isn't too easy to measure it [12].

Some examples of the economic evaluation in dental health services are presented table 1.

In conclusion, in dentistry, cost-effectiveness and cost-benefit studies are carried out much more frequently that cost-utility. A major number of cost-effectiveness studies have looked at prevention programmes and different restorative materials. There is a need for more health economic evaluations within dentistry to be able to use scarce resources efficiently.

Table 1 Economic analysis in dentistry

Authors, year	**Economic analysis Programme**	**Conclusions**
Antczak-Bouckoms and Weinstein, 1987 [13]	**Cost-effectiveness analysis** Periodontal disease	Conservative non-surgical treatments for periodontal disease control not only have costs lower than surgical alternatives, but also maximize expected quality-adjusted tooth-years over a wide range of estimates
Arrow, 2000 [14]	**Cost-effectiveness analysis** Preventive Dentistry	An incremental cost-effectiveness ratio of a $40/child/year after two years for the test programme was found.
Griffin *et al.*, 2001 [15]	**Cost-minimization analysis** Preventive Dentistry	The annual per person cost savings resulting from fluoridation ranged from $15.95 in very small communities to $18.62 in large communities
Speight *et al.*, 2006 [16]	**Cost-effectiveness analysis** Oral cancer screening	Opportunistic high-risk screening, particularly in general dental practice, may be cost-effective. This screening may more effectively be targeted to younger age groups, particularly 40-60 year olds
Mariño *et al.*, 2012 [17]	**Cost-effectiveness analysis** Preventive Dentistry	Based on cost required to prevent one carious tooth among schoolchildren, salt fluoridation was the most cost-effective, with APF-Gel ranking as least cost-effective
Kolstad *et al.*, 2015 [18]	**Cost benefit analysis** Pediatric Dentistry	The purpose of this study was to perform a cost-benefit analysis of the age one dental visit for privately insured patients **Conclusion:** There is an annual cost benefit in establishing a dental home by age one for privately insured patients.
Kumdee *et al.*, 2018 [19]	**Cost-utility analysis** Oral cancer	The screening program is found to be cost-ineffective for oral precancerous detection in Thailand.

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