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Review Article

Health Economics – Oral Health Care Perspective

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Abstract: Health economics is a branch of Economics concerned with issues related to scarcity in the allocation of health and health care. Economic evaluation is necessary to produce the best health care and maximum benefit with minimum cost to the community based on available resources. Countries all over the world are facing increased burden of health care. Public fund available to the health sector are often short of what is required. This situation is a common feature in developing countries. Due to heavy disease burden and implementation of advanced technology, the cost of health care services has been increasing. In view of the problem of mismatch between demand and supply, health economics has become an important area of health care system. We know very well what kind of management we should do in what situation, but we don't have fair idea about how feasible it will be for the entire population. Till date, most of the dental treatments are out of reach for the impoverished people as they cannot afford quality dental treatments because of their high cost. Very little work has been done to economically evaluate the diagnosis and treatment modalities available in the field of dentistry. Considering the limited availability of scientific literature on health economics in dentistry, our objective was to economically evaluate the available oral health care services concisely to enable decision-making and policy-making.

Keywords: Health; economics; economic evaluation; cost; oral health care services

INTRODUCTION:

Human wants are several times more than the productive capacity of our limited resources; it is therefore difficult to satisfy our material wants. The means of producing goods and services are limited and scarce. Our desires for goods and services cannot be completely satisfied. Over time wants of man change and multiply and this might be a result of development of new products and extensive promotion of the product or change in circumstances.

The term "ECONOMICS" is derived from two Greek words, "*okios*" (meaning house) and "*nomos*" (meaning law) [1]. Economics is a social science which deals with human wants and their satisfaction. Health can be seen as an economic good or service. The nature of health is such that it can be seen as a collective good. Collective goods (or social goods) are defined as the public goods that could be delivered as private goods, but are usually delivered by the Government for various reasons, including social policy [2].

Economics applied to the health field or "Health Economics" seeks *inter alia* to quantify over time the resources used in health service delivery, their organization and their financing; the efficiency with which resources are allocated and used for health purposes; and the effect of preventive, curative, and rehabilitative health services on individual and national productivity [3].

Countries all over the world are facing increased burden of health care. Public fund available to the health sector are often short of what is required. This situation is a common feature in developing countries. Costs of medical care is increasing due to heavy disease burden, technological changes and increasing cost of required inputs for health care. In view of the problem of scarcity, health economics has become an important area of health care system [2].

In the perspective of dentistry, very little work has been done to economically evaluate the diagnosis and treatment modalities available. We know very well what kind of management we should do in what situation, but we don't have fair idea about how feasible it will be for the entire population. Till date, most of the dental treatments are out of reach for the impoverished people as they cannot afford quality dental treatments because of their high cost. Therefore, the economic evaluation of dental health care is becoming a matter of utmost importance. This review article focuses on the current status of economic evaluation of available oral health care services.

Definition and dimensions of health economics:

Health is a state of complete physical, mental and social well-being and not merely an absence of disease or infirmity [4]. Health economics has been defined as the application of the theories, concepts, and techniques of economics to the health sector. It is concerned with issues like allocation of resources within the various health care strategies, quantity and quality of resources used in health care delivery, funding of health care services, efficiency in using resources allocated for health care and the effects of preventive, curative, and rehabilitative health services on individuals and the society [2].

Health economics is actually the study of how scarce resources are allocated among alternative uses for the care of sickness and the promotion, maintenance and improvement of health, including the study of how healthcare and health-related services, their costs and benefits, and health itself are distributed among individuals and groups in society. Economic evaluation in modern health care systems is seen as a transparent scientific framework that can be used to advance progress towards improvements in population health at the best possible value [5]. Drummond (1997) defined Economic Evaluation as "Comparative analysis of alternative courses of action in terms of both their costs and consequences" [6].

A number of techniques have been described for complete economic evaluation. Ideally, the evaluation should be linked with a clinical trial so that both costing and consequence data can be collected simultaneously. The latter is a lengthy and expensive process and evaluations often use existing medical literature in order to provide data on consequences. If this method is used, the data may not be accurate and certain assumptions may have to be made. Four main analyses exist for full economic evaluation:

1. Cost-minimization analysis
2. Cost-effectiveness analysis
3. Cost-utility analysis
4. Cost-benefit analysis [6]

Cost-minimization analysis: Cost-minimization analysis (CMA) is used when interventions or procedures are expected to have the same or similar outcomes [7]. The costs of each intervention are assessed, and the least costly can be identified. An example of this is seen where the costs of laparoscopic and 'open' procedures to treat appendicitis are compared. Both types of procedure have an equivalent outcome but laparoscopic appendicectomy has a higher cost [8]. CMA is often initially conceived as a 'cost-effectiveness analysis' (CEA) but the latter is more complex, involving full evaluation of both costs and outcomes of treatments. CEA can then be simplified to a CMA, if it is found that the outcomes for each intervention are equivalent. Few procedures are likely to have the same outcome, and therefore CMAs are considered to be of use in only a limited number of situations [7].

Cost-effectiveness analysis: Cost-effectiveness analysis (CEA) can be used where the outcomes may vary, but they are expressed as common units thus enabling comparison. As well as measuring the costs of the interventions, a measurement of effectiveness is required which is defined in appropriate units. For example, costs can be compared using common units, such as 'per lives saved' or 'per pain free day'. A CEA can therefore be used to compare heart surgery and kidney transplantation, when the common unit of measurement to be used is the number of life years saved. In summary, CEA studies express effectiveness in a single dimension in order to enable direct comparison of costs [9].

CEA cannot be used in the evaluation of procedures where units of outcome vary. It is not appropriate to compare a treatment for reduction of caries and a treatment for oral cancer since the measures of effectiveness are bound to be different. It can be argued that the one-dimensional outcome measure is a substantial flaw since only one consequence of the intervention is investigated. The outcome measure may not be a valid representation of the effectiveness of a treatment, because the patients' subjective experiences are not taken into account [10].

Cost-utility analysis: The cost-utility analysis (CUA) aims to overcome the one dimensional limitations of a CEA using utility-based outcome units to compare different interventions [11]. Utilities are cardinal values assigned to health states and are a measure that an individual holds for certain states of health or disease [12]. The utility value is a number that represents a

condensation of the biological, physical, sociological, and psychological parameters which influence a person's well-being. The value is based on a scale of 0 to 1, where 0 represents death and 1 perfect health. The utility-based measure can then be expressed in terms of 'quality adjusted life years' (QALY), using a simple calculation, and the QALY acts as a common unit. A utility therefore attaches a number to an outcome, which in some sense represents the strength of preference for the outcome relative to others. If the utility value is multiplied by the life expectancy of the subject, a QALY is derived. The gain in QALYs as a result of a treatment can subsequently be assessed. Combining costs with gains in QALYs as a result of a treatment can then provide the cost per QALY gained enabling different treatments to be compared, even if the treatments have completely different outcomes. Importantly, life-enhancing treatments can be compared with life-saving treatments. Various techniques exist to calculate utility values. They all involve detailed and time-consuming intensive interviews with subjects [13].

Cost-benefit analysis: Cost-benefit analysis (CBA) is considered to be the most flexible method of economic evaluation. A CBA aims to place monetary values on both inputs and outputs, i.e. treatment costs and consequence costs. This allows health costs and consequences to be compared with not only other health-related costs and consequences but also non-health-related costs and consequences. Since both costs and consequences are measured in monetary units, it is possible to calculate whether a treatment delivers an overall gain to society. CEA and CUA are unable to provide this information as costs and consequences are measured in different units. In a CBA, the effects of treatments, such as complications, number of disability days, and number of life years gained, need to be converted into costs. This is not easy, but ultimately allows the results of the analysis to be expressed in terms of either a ratio of cost to benefits or the net benefit (or loss) due to the treatment. CBA therefore provides an absolute cost of a treatment [14]. (Table 1)

Table 1: Formulations of economic evaluation in health care by Drummond *et al.;* [6]

Evaluation technique	Formulation
Cost minimization analysis (CMA)	(C1 – S1) (C1 + C2 + C3) – (S1 + S2 + S3)
Cost-effectiveness analysis (CEA)	(C1 – S1)/E [(C1 + C2 + C3) – (S1 + S2 + S3)]/E
Cost-utility analysis (CUA)	(C1 – S1)/U [(C1 + C2 + C3) – (S1 + S2 + S3)]/U
Cost-benefit analysis (CBA)	(W) – (C1 + C2 + C3) [(W + V + S1 + S2 + S3) – (C1 + C2 + C3)]

C=Cost, S=Saving, E=Effect, U=Utility, W=Willingness to pay, V=Value

Economic evaluation in oral health care:

Despite the continued urging in recent years for more economic evaluations in dentistry, and more evidence-based dentistry, there is remarkably little information available regarding the cost-effectiveness of different restorative materials and treatments undertaken for the same patient populations in private dental practices (Table 2). The little information that is available is largely based on estimates of restoration survivals and costs from widely differing populations and on speculations on future, long-term restoration re-treatments and their relative costs [15-23].

Most economic studies of cost-effectiveness have been of poor quality, and no valid comparisons of the cost-effectiveness of different restorative materials placed in dental practices have been published to date. Significantly, when different restorative materials or treatments are recommended by practitioners, evidence-based treatment information is becoming increasingly important for the legal requirements of informed patient consent. Third party funding providers also have a responsibility for the most effective use of limited healthcare resources [24, 25].

Table 2: Literatures on the economic evaluation of different dental health care services

Authors	Year	Conclusion
Dental caries		
Stephen & Campbell [26]	1978	DMFS reduction of 81% in test group with fluoride tablets resulting in an overall cost saving of £178
Horowitz & Heifetz [27]	1979	$1.00 per averted DMFS with fluoride mouth rinse
Horowitz & Heifetz [27]	1979	$1.00–$21.30 per averted DMFS with Topical fluoride applications
Leverett *et al.;* [28]	1983	Selective placement of sealants on teeth of patients who show early evidence of caries activity can improve the cost-effectiveness of the procedure.

Klein *et al.;* [29]	1985	Community water fluoridation was reaffirmed as the most cost-effective means of tooth decay in children
Simonsen *et al.;* [30]	1987	Cost-effectiveness ratio = 1:2 by using fissure sealant
Manau *et al.;* [31]	1987	$2.26 per averted DMFS with fluoride mouth rinse
O'Rourke *et al.;* [32]	1988	Cost-benefit ratio =£4.39/£3.23 per child with fluoride tablets
Goggin *et al.;* [33]	1991	IR*£9.66 per tooth surface saved by using Mouth rinse and sealant
Widenheim & Birkhed [34]	1991	SEK**167 per tooth surface saved with fluoride tablets
Vehmanen *et al.;* [35]	1993	Cost-benefit ratio = 1:5 by using fluoride mouth rinse
Vehmanen *et al.;* [35]	1993	Cost-benefit ratio = 1:8 by using fluoride varnish
Petersson & Westerberg [36]	1994	Net benefit of SEK1 120 for saving 2.54 DFSs in test group with fluoride varnish
Sköld *et al.;* [37]	1994	SEK1 175 per averted DMFS with fluoride varnish
Morgan *et al.;* [38]	1998	AU$11.80 per averted DMFS with fissure sealant; Cost-effectiveness ratio = 1:41
Marynuik *et al.;* [39]	1998	Potential lifetime cost saving can be between 11%-24% if the first replacement of a failed amalgam restoration is done with another amalgam instead of with a crown
Wrigh *et al.;* [40]	1999	The cost-effectiveness analysis of water fluoridation has some particular strength as it is based on recent dental data, reflecting the reduced rates of dental caries in both fluoridated and non-fluoridated areas, it includes dental treatment savings as a negative cost, it has a relatively long time horizon, and it includes an assessment of benefits to adults.
Chadwick *et al.;* [41]	1999	Dental amalgam is the direct restorative material with the longest duration and from the perspective of the NHS is of lower cost.
Arrow *et al.;* [42]	2000	Less cost in fluoride sealant group
Werner *et al.;* [43]	2000	$65 and $42, respectively, per saved tooth surface in a dental clinic and a school-based application of fissure sealant
Department of Health, London [44]	2000	Community Water Fluoridation can result the cash savings account to ₤84,000-₤1,60,000 per annum by reducing the number of tooth extraction per year in Manchester.
Griffin *et al.;* [45]	2001	On the basis of the most current data available on the effectiveness and cost of fluoridation, caries increment and other cost and longevity of dental restoration, the water fluoridation is found to be a significant cost saving modality.
Griffin *et al.;* [46]	2002	Range from cost savings up to a cost of $73.96 per child for three delivery strategies of fissure sealant
Kelly *et al.;* [47]	2004	The direct placement restorations were more cost-effective than the indirect restorations
South Central Strategic Health Authority, Scotland [48]	2008	Community Water Fluoridation resulted in a 49% saving in dental treatment costs for children aged 4-5 years and a 54% saving for children aged 11-12 years
Ran *et al.;* [49]	2016	The economic benefit of community water fluoridation exceeds the intervention cost and the benefit–cost ratio increases with the community population size
Periodontal disease		
Antczak *et al.;* [50]	1987	Conservative non-surgical treatments for periodontal disease control not only have costs lower than the surgical alternatives, but also maximize the expected quality adjusted tooth years over a wide range of estimates
Lissovoy *et al.;* [51]	1999	The CHX chip is a new, apparently cost-effective treatment option of non-surgical periodontal therapy
Gaunt *et al.;* [52]	2011	The supportive periodontal care in specialist periodontal practice is usually more cost-effective than in private dental practice

Dom *et al.;* [53]	2014	It is very cost-effective for the public sector to provide specialist periodontal treatment for patients with periodontitis according to the World Health Organization criteria and when compared with conventional biannual dental treatment.
Malocclusion		
Severens *et al.;* [54]	1998	Pre surgical orthopaedic treatment in children with complete unilateral cleft lip and palate is cost-effective
Oral cancer		
Meij *et al.;* [55]	2002	Screening of oral cancer in early stage of oral lichen planus patients is cost- effective
Speight *et al.;* [56]	2002	Opportunistic high-risk screening, particularly in general dental practice, may be cost-effective
Sujha *et al.;* [57]	2009	The most cost-effective approach to oral cancer screening by visual inspection is to offer it to the high-risk population
Dental Fluorosis - No data		
TMJ disorders - No data		

*Irish, **Swedish Krona.

In case of mobile dental care, planning and operating a mobile dental unit require serious consideration of many logistical factors including staff recruitment, maintenance, repairs, insurance and commitment of school officials and teachers. From a financial perspective, they require a high capital investment. Therefore, a careful financial analysis must be conducted prior to engaging in any such enterprise, especially when the target population includes the uninsured and individuals covered by public insurance programs. Mobile dental services are, by definition episodic in nature. Ideally, they should be visualized as the spearhead of development, preparing communities for the ultimate provision of more permanent services, i.e., a fixed dental facility. However, in many communities, this may not always be possible. In these particular situations, mobile dental programs can play a vital role in providing access to care to underserved populations and ensuring this mission requires long-term planning. Careful financial viability and capital budgeting analysis based on sound assumptions are excellent decision-making tools. Their value can be improved if the analysis is presented in worst-case, most likely case and best-case scenarios [58].

Future development of economic evaluation in the field of oral health care:

Health economic evaluations in dentistry are still at the developmental stage. Despite the fact that public dental health care might not yet be prepared for the immediate implementation of such evaluation techniques, there is still no reason for not to begin the process and thus contribute to further development of suitable methods [59].

In dentistry, the method of cost-effectiveness analysis, and methods for economic evaluations and policy analysis in general, are in their infancy. The number of published cost-effectiveness analysis is limited and an application of strict criteria to assess the validity of those analyses would dramatically reduce the number of methodologically sound studies [60]. By broadening the decision-making basis to include different perspectives and analysis such as CEA, OHRQoL (Oral Health Related Quality of Life) measures, and CBA, contributions to further progress can be made. It should be remembered that different outcome measures give different information, and these new techniques are complements rather than substitutes.

The following method of opening the health economic perspective to the decision maker in preventive dentistry is suggested: Firstly, make an inventory to identify and establish actual baseline data in terms of both finance and health. Secondly, stipulate clear and well-defined overall health objectives from both clinical and patient oriented perspectives. Thirdly, establish treatment objectives for different patient categories with well-defined outcome measures consistent with the overall health objectives, beginning with the two main oral diseases, caries and gingivitis/periodontitis. Health promotion, maintenance care, and treatment of disease must all be considered, and both costs and consequences should be explicit in the budget. Fourthly, implement a CBA prior to the planning process to discover the preferences and WTP for preventive dentistry among the adult population. Fifthly, implement different preventive strategies. Before implementation, analysis of individual preferences, health objectives, expected result of preventive measures, resource accessibility, and allocation policy must be undertaken in order to create the best health outcome. Sixthly, perform continuous follow-ups (centralised or local) to compare health outcomes with costs (CEA, CBA, OHRQoL). Health organisations should be obliged to consider these perspectives in the recurrent budget process [59].

One practical suggestion is that dentist time is best used for consultation, therapy planning, and rehabilitation of the minority of individuals with increased health care demands, while dental nurses can be used for more standardised population-based strategies. Dental hygienists, with their preventive and health promoting profile, are best suited for handling oral health controls as well as working with the dentist on therapy planning and evaluation of treatment for the small group at high risk. However, it must be remembered that proper allocation of resources is not just a matter of calculating costs and outcomes but also has an inherent dilemma of equity. The distribution of disease and links to factors such as ethnicity and socio-economic background must be taken into account by decision-makers and prevention and resources should be allocated to all individuals in a just and equitable way [59].

In future, economic evaluation is likely to become more important in dentistry and health service purchasers will look for evidence on clinical effectiveness of treatments as well as information on 'value for money' when allocating resources. The types of care practised and treatments prescribed could be evaluated with regard to their efficacy, usefulness, value to public health and economic impacts on society. This could help identify the most respectful and ethical practices, support the best use of medicines, obtain positive clinical outcomes and reduce costs. With this information, the health authorities could then make optimal choices [61]

CONCLUSION:

The impact of health economics is felt not only within the discipline of economics but also outside the field [62]. As the health of the population will not be improved just by spending more money on health care, the understanding of health economics is essential to properly implement the economic policies for the health care enhancements. Hence, the policy makers and the dental personnel should have adequate knowledge regarding the same for providing better health services. The costs or, in, general the economic effect of the emerging new technologies like Genome Sequencing are of special interest especially from a public health point of view. Since there are on-going discussions on the application of these technologies to every new-born, to all newly diagnosed cancer patients or to even the broader population, it is necessary to focus on health economic aspects in order to gain insight into the potential public health impact [63].

One way to increase India's health care funding and access is through innovative public-private partnerships. While an appropriate model for partnerships at the primary, secondary, and tertiary levels still remains a distant dream, participation by the Government and private sector will help create a blueprint for such partnerships to create an infrastructure for the future. Among other suggestions to improve care, companies should leverage information technology to create patient-centric healthcare systems that can improve response times, reduce human error, save costs, and impact the quality of life. The Government should invest in preventive and social medicine by promoting health education and preventive health-care concepts [64]. Besides, in the perspective of the current scenario of handful evidences of economic evaluation in oral health care services, both the Government and third parties should encourage more and more researches on economic analysis which will ultimately help the dental treatments to become much more accessible to the general population.

In the context of health economics personnel, though post graduate course on Health Economics is taught in some universities and medical institutions, India is still lacking the post of health economist in the health care system both in state and central level. If this post is created in all the medical, dental and other health institutions, the health economists will help to evaluate the financial concerns of all the health programmes. Their analyses will definitely support the health care delivery programmes to be more accessible to the entire population.

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