Economic Outcomes in Prosthodontics

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Purpose: A systematic literature review was conducted to identify the types of economic measures currently used in implant prosthodontics and determine the degree to which cost of care is considered in the context of any positive outcome of the care provided. ***Materials and Methods:*** A literature search was conducted using the following set of terms plus some additional hand searching: "dental implants" (Mesh) AND ("cost") OR "maintenance" OR "healthcare policy" OR "access to care" OR "third party" OR "economic") AND (("1995/01/01"[PDat]:'2009/12/31"[PDat]) AND (Humans[Mesh]) AND (English[lang])). ***Results:*** After a review of the 466 titles and abstracts identified by the search, 18 articles were accepted for further consideration, as some attempt at economic outcome measures was made. An additional four articles were identified by hand searching. The 22 accepted articles were grouped into four basic categories: *(1)* measure of costs of treatment (direct, indirect, and maintenance costs), *(2)* cost-effectiveness mathematical modeling applied to simulate the lifetime paths and cost of treatment, *(3)* cost-effectiveness analysis/cost-minimization, and *(4)* willingness-to-pay, willingness-to-accept. Attempts at determining the costs of treatment varied widely. When the OMERACT filters were applied to the various measures it was felt that discrimination and/or feasibility was a problem for most of the current economic outcome measures. ***Conclusions:*** Measures of cost-benefit, cost-effectiveness, and cost-utility are currently the gold standard; however, feasibility of such analyses is an issue. Collaboration with health economists to guide future research is highly recommended. *Int J Prosthodont 2013;26:465–469. doi: 10.11607/ijp.3405*

It is estimated that billions of dollars are expended on prosthodontic care worldwide. Yet our current awareness of the direct costs, such as monetary expenditures, and indirect costs, such as time relative to treatment and maintenance phases of therapy, is limited. There are few centers conducting economic

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analyses, and most reports focus on edentulous patients only. Although a small number of articles on this particular subject have been published in the dental literature, this information could be crucial in light of dwindling health care dollars.

The answer to the simple question of "Is treatment worth the cost?" remains elusive. The comparative benefit of different therapies that influence clear "yes/no" outcomes, such as "life/death," are the easiest to assess. In dentistry, the necessity for teeth to preserve life is unproven, and depending upon the clinical condition of teeth and surrounding tissues, it has been suggested that teeth may be a detriment to systemic health in certain circumstances.[1] Dentistry, therefore, must focus mainly on outcomes that relate to psychologic and/or functional improvements over time relative to costs incurred to achieve improvement.

Placing the cost of prosthodontic treatment in the context of the benefit, effectiveness, or utility of the treatment is assumed to be of compelling importance to patients, health care providers, governments, third party payers, and society in general. Economic analyses in health care fall into several broad categories: cost-benefit/willingness to pay/accept, cost-effectiveness/cost-minimization, and cost-utility analyses.[2,3]

Cost-benefit analysis (CBA) attempts to compare the total expected cost of options against the expected benefits, usually including physiologic and psychosocial impacts. It is used to compare a patient's preference or "willingness to pay" for different treatments.

Willingness to pay (WTP)/willingness to accept (WTA) analysis uses surveys to estimate the value (monetary) that members of a population place on different treatment options. In willingness to pay, individuals are asked to state the maximum amount they would be willing to pay for a treatment. The individuals surveyed may or may not be patients. In willingness to accept, the situation is reversed in that individuals are asked to state the minimum amount they would need to be paid to stop a treatment. Again, the individuals surveyed may or may not be patients.

Cost-effectiveness analysis (CEA) compares the cost expended on a specific therapy with the benefit obtained for that therapy. These types of economic analysis require strong prior evidence of effectiveness. For example, dental caries in children leads to lost school hours. A CEA could be conducted to compare the expenditure to treat or prevent dental caries with the expenditure of offering extra schoolroom hours or lowered schoolroom performance of children who are missing school. In CEA, means or estimates are often used to calculate "cost saved."

Cost-minimization analysis (CMA) compares two forms of therapy that have similar effectiveness outcomes based upon cost (in monetary units) to determine which of the two therapies is less costly. The major weakness of CMA is that meeting the prerequisite of having two identical therapies is rarely possible. Hence, CMA remains the least used form of health care analysis (HCA).

Cost-utility analysis (CUA) assesses the cost (in monetary units) expended on a specific therapy relative to the value received from that therapy. Measuring "value" can be challenging, and the two most common methods in health care are change in quality of life or in the length of life. Awareness of the time over which the benefit endures is a key component of CUA and is most often represented by calculating quality-adjusted life years (QALYs) as the primary measure of value. However, it should be noted that some scholars include QALY under the CEA umbrella as well.

In this paper, results are presented from a systematic literature review conducted to identify the types of economic measures currently used in implant prosthodontics, and the degree is determined to which cost of care is considered in the context of any positive outcome of the care provided.

Materials and Methods

A literature search was conducted using the following set of terms plus some additional hand searching: "Dental implants" (Mesh) AND ("cost") OR "maintenance" OR "healthcare policy" OR "access to care" OR "third party" OR "economic") AND (("1995/01/01"[PDat]:'2009/12/31"[PDat]) AND (Humans[Mesh]) AND (English[lang])). A total of 466 articles were identified.

After review of all 466 titles and abstracts, 18 articles were accepted for further consideration. These included articles in which some attempt at economic outcome measures was made. An additional four articles were identified by hand searching. The OMERACT filters of truth, discrimination, and feasibility were applied to the various economic outcome measures identified in the review to determine if any met all the criteria.

Results

In reviewing the 466 abstracts, it was determined that numerous economic terms were used; however, in the majority of articles, no attempts to measure costs of treatment or economic measures or analyses were made.

The 22 accepted articles can be grouped into four basic categories: *(1)* measure of costs of treatment

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Table 1 Economic Costs Measured

Initial treatment: Direct cost*
Surgery fees (OR time, anesthesia, hardware)
Hospital fees (lab tests, radiographs, EKG, OR, hospital room medications)
Professional fees (surgery, prosthodontic, laboratory, assistant, dental hygienist)
Component costs (equipment, implants, prosthesis, instruments, disposables)
Initial treatment: Indirect cost
Professional time associated with maintenance events
Clinic overhead costs
Indirect patient costs
Time (salary rate/h)
Other expenses (travel costs, parking)
Maintenance costs (scheduled and unscheduled)
Periodontal maintenance, prosthodontic maintenance, damaged hardware (mechanical complications), loose framework, remake of implant prosthesis, reline of overlay or opposing denture, annual recall visits, unscheduled adjustments visits, adjust occlusion, repair denture base, replace denture tooth, adjust attachment clip, replace attachment housing, replace attachment, retighten attachment, conversion of prosthetic plan, fracture opposing denture, remake opposing denture, time to retreatment, revision costs
Mean ± SD for clinical visits/y (after first y) for maintenance and recall

OR = operating room, EKG = electrocardiogram, SD = standard deviation.
*Costs will vary for university vs a private practice setting.

(direct, indirect, and maintenance costs),[4–13] *(2)* cost-effectiveness mathematical modeling applied to simulate the lifetime paths and cost of treatment,[14–16] *(3)* cost-effectiveness analysis/cost-minimization,[17–24] and *(4)* willingness-to-pay, willingness-to-accept.[25] Attempts at determining the costs of treatment varied widely (Table 1). When the OMERACT filters were applied to the various measures, it was felt that discrimination and/or feasibility was a problem for most of the current economic outcome measures.

Discussion

This systematic review highlights the paucity of information regarding economic analyses in prosthodontics; the known is dwarfed by the unknown, and clinical decision making must occur in this vacuum relative to the cost of prosthodontic care. Nevertheless, the challenges to conducting HCAs in prosthodontics need to be overcome, and the single most difficult impediment to progress is the lack of validated clinical outcomes that can be used to compare and contrast direct and indirect costs. The lack of validated outcomes stems, in turn, from a lack of consensus on which outcomes are important to measure and how they are best measured. In the continuum of reaching our discipline's goal of providing optimal prosthodontic care, economic analyses are best conducted after well-defined and validated measures of benefit, effectiveness, utility, quality, and/or value related to psychologic or functional gains are available. More recently, patient satisfaction has been proposed as a summarizing variable of patients' perception of the benefit of care.[26] A primary goal of the ORONet is to address this void by proposing and validating psychologic and functional outcomes from a patient-focused perspective.

Capturing initial and maintenance costs of various treatments is important for cost comparisons, cost-minimization strategies, and other economic analyses. There are certain important considerations with respect to cost of treatment estimates. As new technologies or treatments become available there is always a learning curve. Treatment costs may be lessened once the surgical or prosthetic techniques are established. Direct comparisons are difficult due to nonstandardized surgical, clinical, and laboratory procedures and length of follow-up period. Variability in the intensity or complexity of treatment and characterization of the subjects such as psychologic adaptability also affect the outcomes. Differences between service delivery systems such as university versus private practice settings will greatly impact costs. International issues such as exchange rate at time of service, standardized currency, and inflation further complicate cost comparisons. Finally, cultural, national, socioeconomic, racial, ethnic, generational, and gender differences, to list some important variables, markedly influence perception of value.

The opportunities to transform the stimuli and priorities of prosthodontic care far outnumber the challenges to successfully implementing an

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economic HCA program. That conducting economic HCAs is difficult is acknowledged because of the shortage of answers to very important questions, such as:

1. What information should be captured?
2. How should it be captured?
3. How should it be analyzed?
4. How should it be interpreted?
5. How will the conclusions be used?

Clearly, it would be easy to fall into a circular argument of "How can one conduct research in this area when there is almost no research to guide future research?" Nevertheless, prosthodontics must forge ahead and conduct initial research with the recognition that successes and mistakes of study design and data interpretation are likely and necessary and that much will be learned from these successes and mistakes. Currently, work by Zitzmann et al (CEA),[19] Walton and Layton,[26] Bouchard et al (CE modeling),[15] Attard et al (CEA/CMA),[13] Esfandiari et al (WTP/WTA),[25] Pjetursson et al (CEA/patient centered),[22] and Pennington et al (CE modeling)[14] offer a few examples of well-conducted research to guide clinician scholars with methodology. Although CEA is the current gold standard, feasibility and validity are an issue. Identifying point-of-care data-capture methodology that is practical for the patient and practitioner, of minimal detriment to efficient clinical practice, accurate, inexpensive, safe, and noninvasive will undoubtedly open the door for widespread acceptance by prosthodontic practitioners and lead, ultimately, to large datasets on which well-founded decisions regarding care can be made.

It is important to consider economic analyses in the context of evidence-based practice (EBP). The issue of compliance with EBP guidelines haunts medicine and dentistry since a variety of reasons preclude their acceptance and use. Both health care providers and patients struggle with adherence, and one must consider the key drivers of decision making, such as cost sharing, when considering which outcomes to prioritize.[27] The rapid growth of medical and dental costs augurs poorly for care to be available to larger segments of society than currently have access to care. It is imperative, therefore, that valid and relevant economic analyses be conducted to facilitate the best possible decisions regarding how limited financial resources will be utilized.

Conclusions

An imperative to understand the cost of interventions exists if prosthodontics is to serve the best interests of patients. The opportunities to influence key health care decisions for community or individual care are significant since few centers are conducting the type of analyses vital to addressing the issues of cost and prioritization of care. Indeed, given the amount of care that is provided annually in the world, there is so little economic analysis information available that treatment recommendations based upon large cohorts are difficult to justify at this time regarding any single clinical condition, prosthodontic intervention, or validated economic measure. Simply put, if the input data regarding outcomes are invalid, the output data regarding economic analyses will, by definition, be consequentially invalid. With inclusion of treatment parameters and longevity data, combined with patient perceptions of satisfaction and function (OHIP), some estimates may be possible.

Measures of cost-benefit, cost-effectiveness, and cost-utility are currently the gold standard; however, feasibility of such analyses is an issue. Patient-centered measures of determining value such as willingness-to-pay/willingness-to-accept are more feasible, but the validity may be an issue, and more studies need to be done. Collaboration with health economists to guide future research is highly recommended.

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Literature Abstract

Osteonecrosis of the jaw onset time are based on the route of bisphosphonate therapy

This retrospective cohort study investigated the relationship between the duration of bisphosphonate (BP) therapy and the onset of osteonecrosis of the jaw (ONJ) based on an intravenous (IV) or oral route of administration. Data related to medical history, demographics, and clinical events associated with the onset of ONJ were collected from 114 patients treated for ONJ between 2008 and 2011. The duration of BP therapy and associated triggers (dentoalveolar surgery, extractions, or spontaneous occurrence) were also examined. Seventy-six patients had a history of IV BP therapy, while 38 patients had oral BP therapy. Patients who had undergone IV BP therapy developed ONJ earlier than patients with oral BP therapy, with a median time to onset of 3 years in the IV BP group and 5 years in the oral BP group. No significant differences were found in the duration of BP to the occurrence of ONJ associated with dental extractions compared to spontaneous occurrence in both the IV and oral BP groups. In summary, the authors found an earlier onset of ONJ in patients undergoing IV BP therapy compared to oral BP therapy, but there was no correlation to dentoalveolar surgery. This lack of evidence to suggest increased risk of ONJ after dental extractions may provide support for dentoalveolar surgeries indicated in patients with a history of BP therapy.

Fleisher KE, Jolly A, Venkata UD, Norman RG, Saxena D, Glickman RS. *J Oral Maxillofac Surg* 2013;71:513–519. **References:** 82.
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