

**AAO Foundation Awards
Final Report**

1. Type of Award (Check One):
 Biomedical Research Award: Applicant Defined
 Orthodontic Faculty Development Fellowship Award
 Center Award
 Educational Innovation Award
 Program Award
 Research Aid Award (Access to Care Awards)
2. Name(s) of Principal Investigator(s): Greg King
3. Institution: Univ of Washington School of Dentistry
4. Period of AAOF support (e.g. 07-01-08 to 06-30-09): 07-01-09 to completion
5. Amount of AAOF Funding: \$20,000



6. Signature: _____ Date: June 24, 2011

PLEASE ADDRESS EACH CATEGORY SEPARATELY (single spaced)

1. **Specific Aims** (page 1)
 1. Compare the cost-effectiveness of interceptive orthodontics with full treatment orthodontics from clinician, patient/parent perspectives. We hypothesize that the cost-effectiveness of these two approaches for Medicaid patients will differ from the various perspectives. These data will provide policy makers with the broadest possible viewpoint upon which to base funding decisions.
 2. To assess the impact of malocclusion severity, child's age, gender, ethnicity, pre-treatment quality of life, and level of compliance on the cost-effectiveness of each strategy.
2. **Studies and Results** (page 1 up to page 2 or 3)

Complete data from Specific Aim 1 will be necessary in order to do the statistical modeling proposed in Specific Aim 2. We have obtained micro-cost data from each of our 150 RCT subjects. This was done by conducting a complete review of all progress notes for all subjects, categorizing each appointment by type (e.g., screening, records, appliance placement, etc.). We have also completed a listing of costs by appointment category using currently available supply, staff and overhead data. We have used those data to calculate a specific cost for treatment of each subject. We have used already acquired data on effectiveness to calculate cost-effectiveness for the two types of treatment from the perspectives of the clinician (using ICON scores) and Medicaid (using the Washington State reimbursement schedule). Unfortunately our psychologist collaborator (Dr. Asuman Kiyak) passed away before we could complete our goal of calculating cost-effectiveness from the patient/parent perspectives so we have not yet completed that. However, all of the required effectiveness data (Body Image) are available and all we need is to recruit a new psychologist to assist us in its interpretation.

Since we have complete data from Specific Aim 1 from the clinician and Medicaid perspectives, we are doing multivariate modeling of several risk factors (Specific Aim 2) to determine the combinations that predict the most cost-effective strategies for managing malocclusion treatment under Medicaid. This will be done from the patient/parent perspectives as a no-cost extension of this grant activity.

In planning our cost-effectiveness analyses, we became aware that there were no papers in the literature that broadly presented the burdens associated with having a malocclusion in our society and a conceptual framework that is required to fully assess the cost-effectiveness of providing treatment for underserved populations. The minimal relevant literature focuses more selectively on the direct costs of treatment in developed countries that have extensive publicly supported health schemes and does not actually assess the burdens associated with having a malocclusion and obtaining care, especially in the health care environment that currently exists in the US. Therefore, we put considerable effort into preparing a manuscript that was published in the Journal of the American Dental Association that will describe these burdens and a conceptual framework for analysis. A reprint of this article, which appropriately acknowledges the AAOF funding, is attached to this report. This paper identifies the gaps in our knowledge and should drive future research on providing adequate access to orthodontic services for the underserved in the US. We feel that the experience of our research team with conducting this RCT and economic analysis has provided us with the appropriate perspective to provide such a “burden of illness” paper on malocclusion to the dental profession.

3. **Progress Report** (up to page 6)

A. Progress to date.

- The Burden of Illness paper has been published in JADA
- Micro costing for subjects in our RCT who received interceptive (n = 75) or comprehensive (n= 75) treatment is complete.
- ICON, Medicaid reimbursement and QoL data already exist and have been analyzed separately.
- Data analysis on cost-effectiveness from clinician and Medicaid perspectives is complete and a publication is in preparation.

B. Plans to finish the project.

- Cost-effectiveness from patient (Cost/QoL) will be completed once we recruit a new psychologist collaborator.

C. Subjects (detailed description of sample, including information gender and age).

- 75 interceptive and 75 comprehensive patients
- Most minorities
- Medicaid eligible
- Major malocclusions
- Started the study at age 9.5 years
- Equal genders

D. Publications/presentations.

- Invited presentation for Spring 2010 AAO meeting on access to care studies.
- “Burden of Illness” paper on malocclusion published. (Bresnahan B, Kiyak A, Masters S, McGorray S, Lincoln A and King G, *Quality of Life and Economic Burdens of Malocclusion in US patients enrolled in Medicaid*, JADA 2010;141(10):1202-1212.
- One CE analysis paper from clinician/Medicaid perspectives will be submitted to AJODO.
- One CE analysis paper from patient/parent perspectives will be submitted to AJODO.

E. Listing of investigators, nature of involvement in research, and time allotted since beginning of research.

- Greg King PI 10%
- Asuman Kiyak Co I (Psychologist)--Deceased 10%
- Sue McGorray Co I (Biostatistician) 5% last period but 10-15% next
- Brian Bresnahan Co I (Health Economist) 10%
- Lynn Wang (Research Coordinator) 50%
- Adam Lincoln (Student Volunteer) 10%
- Sam Masters (Student Volunteer) 5%

F. Percentage funding from AAOF and other sources; amount of grant funds already spent.

- All professional salaries are being provided without charge to the grant by the various departments involved
- All students are volunteers working for course credit in Health Policy Research (AL) or Health Economics (SM)
 - **We estimate that approximately 75% of the actual direct costs of conducting the research came from the above sources.**
- The Research Coordinator (LW) is paid from the grant.
 - **We estimate that 25% of the actual direct costs for the above came from the AAOF grant**

G. Request/justification for extension of present cycle: do the investigator(s) foresee a time extension for this project and why?

We have expended the entire amount of the original grant, but intend to continue the project until the two manuscripts described above are published.

4. Illustrations, addendum (limit to 5 pages)

Bresnahan et al.pdf

Quality of Life and Economic Burdens of Malocclusion in U.S. Patients Enrolled in Medicaid

Brian W. Bresnahan, H. Asuman Kiyak, Samuel H. Masters, Susan P. McGorray, Adam Lincoln and Gregory King

J Am Dent Assoc 2010;141;1202-1212

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Quality of life and economic burdens of malocclusion in U.S. patients enrolled in Medicaid

Brian W. Bresnahan, PhD; H. Asuman Kiyak, MA, PhD; Samuel H. Masters, BS; Susan P. McGorray, PhD; Adam Lincoln, BA; Gregory King, DMD, DMSc

Treatment of malocclusion has become common in the United States because patients generally believe that it provides significant long-term benefits in quality of life (QOL) and overall oral health. Despite this, rates of untreated malocclusion remain high among children who are socially disadvantaged (for example, racial/ethnic minorities, immigrants from lower-income families and those living in rural communities), resulting in a substantial oral health burden. Owing to social and economic disparities, these children have limited access to orthodontic services not only because of their families' competing needs for limited resources, but also because of the limited availability of orthodontists in their communities and a shortage of orthodontists who are willing to treat patients enrolled in Medicaid.

The best available estimates of the prevalence of malocclusion in the United States are derived from the third National Health and Nutrition Examination Survey (NHANES III), supplemented by several large epidemiologic assessments of specific subpopulations.

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 Dr. McGorray is a research assistant professor, Division of Biostatistics, Department of Epidemiology and Health Policy Research, College of Medicine, University of Florida, Gainesville.
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 Dr. King is the Moore-Riedel Professor, Department of Orthodontics, School of Dentistry, University of Washington, Seattle.

ABSTRACT

Background. Patients enrolled in Medicaid have limited access to orthodontic services in the United States. No studies are available, to the authors' knowledge, regarding the clinical and psychosocial burdens of malocclusion on these patients from an economic perspective.

Methods. The authors conducted a systematic review of the relevant economic literature. They identified issues from the perspectives of the various stakeholders (dentists, patients and parents, Medicaid programs) and developed a conceptual model for studying decision making focused on the strategy of providing early interceptive and preventive treatment rather than, or in addition to, comprehensive care in the patient's permanent dentition.

Results. Medicaid coverage and reimbursement amounts vary nationwide, and decision making associated with obtaining care can be complex. The perspectives of all relevant stakeholders deserve assessment. A conceptual framework of the cost-effectiveness of interceptive orthodontic treatment compared with comprehensive treatment illustrates the issues to be considered when evaluating these strategies.

Conclusions. Policymakers and the dental community should identify creative solutions to addressing low-income families' limited access to orthodontic services and compare them from various perspectives with regard to their relative cost-effectiveness.

Clinical Implications. Dentists should be aware of the multiple problems faced by low-income families in obtaining orthodontic services and the impact of stakeholder issues on access to care; they also should be proactive in helping low-income patients obtain needed orthodontic services.

Key Words. Malocclusion; economic burden; oral health-related quality of life; Medicaid policy.

JADA 2010;141(10):1202-1212.

The evidence indicates that malocclusion in its various forms is common in the United States and its nature varies considerably among ethnic groups. To illustrate, investigators in NHANES III found that incisor irregularity was highly prevalent across all ethnicities, with 65 percent of adults having misaligned incisors and 15 percent having crowding severe enough to interfere with function and social interactions.¹ Dental crowding is less common in African Americans than it is in whites and Mexican Americans,^{2,3} but dental spacing problems are three times more prevalent in African Americans.²

Researchers have conducted few rigorous economic evaluations of malocclusions in the United States or elsewhere. In this report, we discuss the substantial burdens associated with malocclusion. We consider multiple perspectives regarding conducting economic evaluations, including those of patients, parents, orthodontists and state administrators of Medicaid programs. Last, we provide a conceptual framework for approaching economic assessments and considerations regarding parameters to include in evaluations of cost-effectiveness. The relative burden of correcting this condition is greater for lower-income patients; therefore, the U.S. Medicaid population was the focus of our evaluation.

CLINICAL, PSYCHOSOCIAL AND FUNCTIONAL BURDENS OF MALOCCLUSION

Treatment of malocclusion is common in Western countries because patients and dentists generally believe that it provides esthetic, psychosocial and functional benefits leading to improved overall oral health and QOL.^{4,6} Epidemiologic data suggest that malocclusion is common in the United States, but its presentation and subsequent burdens for patients can vary considerably.¹

Using morphological criteria, Ackerman and Proffit⁷ and Ackerman and colleagues⁸ characterized malocclusions as problems with dental alignment or in the three planes of space (that is, vertical, transverse and anteroposterior). Each of these problems can be subdivided on the basis of whether they are dental or skeletal in origin. The multifaceted nature of malocclusion becomes apparent when we consider that a given patient could have problems in multiple categories. The consequences of a malocclusion on oral health are an increased risk of damage to oral soft tissues, abnormal facial growth and poor mastication.⁹

Medical burden is not defined easily. Most

states prioritize funding for treatment of malocclusion by using a list of specific medical or dental procedures that generally are referred to as “medically necessary” based on clinical circumstances or by establishing criteria that correspond to a condition’s being considered “handicapping.” These include excess overjet that can put incisors at risk of injury, crossbites that cause gingival recession and jaw deflections that can cause abnormal growth patterns. Although to our knowledge there are no large-scale studies to support the health hazards of severe malocclusion, results of smaller-scale retrospective and clinical studies have demonstrated that malocclusions can cause gingival recession,¹⁰ traumatic injuries to the upper incisors because of incisal overjet¹¹ and abnormal growth patterns due to posterior crossbites.¹²

Few investigators have studied QOL issues focused on malocclusion, primarily because of the lack of valid instruments for these conditions and age groups. Also, because most orthodontic treatment is elective, a patient’s perception of the relative utility of treatment should be an important consideration when examining the effect of malocclusion on QOL. When we consider the large number of patients in all age groups worldwide who are motivated to seek treatment for malocclusion, it seems likely that people do perceive these problems as burdensome.

In addition, strong research evidence shows that malocclusion and its treatment can affect oral health–related quality of life (OHQOL). Post-treatment patients in Brazil reported experiencing 1.85 times fewer oral health effects (that is, more positive OHQOL) than their peers who were currently in treatment and 1.43 times fewer effects than those who were never treated.¹³ Adolescents with “a clinically assessed need for orthodontic treatment” reported 2.65 times more dental effects on the OHQOL measures than did other adolescents.¹³

Researchers in New Zealand observed variability in scores on the Child Perceptions Questionnaire (CPQ) among children aged 12 through 13 years with different levels of malocclusion;

ABBREVIATION KEY. **CPQ:** Child Perceptions Questionnaire. **HLD:** Handicapping Labiolingual Deviation. **ICON:** Index of Complexity, Outcome and Need. **NHANES III:** Third National Health and Nutrition Examination Survey. **OHQOL:** Oral health–related quality of life. **PAR:** Peer Assessment Rating. **QOL:** Quality of life.

those with handicapping malocclusion scored worst.¹⁴ Ryan-Taylor and colleagues¹⁵ found that the emotional and social well-being domains of the CPQ (for example, worrying about being different, being teased, avoiding smiling)—not oral symptoms or functional limitations (for example, pain, difficulty chewing)—had the greatest effect on OHQOL. These U.S.-based authors, unlike those who conducted the study in New Zealand, found that malocclusion severity was unrelated to CPQ scores.

Investigators in other studies¹⁶⁻¹⁸ have demonstrated that children anticipating interceptive orthodontic treatment (that is, partial treatment of the child's malocclusion when he or she is in the mixed dentition stage) expected to experience significant improvements in their social and psychological well-being, as well as in their oral function. Parents consistently expected more improvement than did their children in these three domains (that is, social and psychological well-being and oral function).¹⁶ White children expected the most improvement in appearance, while Latino and black children expected improvements in social acceptance.¹⁶⁻¹⁹ The results of earlier studies, as well as those of an ongoing clinical trial,¹⁸ reveal that body image improves in children who have undergone interceptive orthodontic treatment, and it improves even more with comprehensive treatment.

Although clinicians and researchers recognize the physical, functional and psychological burdens of malocclusion, they have not been studied systematically.^{5,20,21} The results of NHANES III show that about one in three children younger than 18 years had a malocclusion that required treatment.¹ Although this need largely is being met in the United States for children from middle- and high-income families,²² a large unmet need for treatment exists among low-income, minority and rural populations.^{23,24}

Most orthodontists believe that patients at risk of developing severe malocclusion can be identified reliably at an early age during the mixed-dentition stage.²⁵⁻²⁸ Moreover, data from a randomized clinical trial conducted by Jolley and colleagues²⁹ suggest that, despite not always resulting in an ideal occlusion, interceptive orthodontics during the mixed-dentition stage can reduce malocclusion severity and move the majority of patients from a medically necessary treatment status to an elective treatment status. The results of the study by Jolley and colleagues²⁹ show that malocclusions do

not improve without treatment and, in fact, may worsen if left untreated or if treatment is delayed until the permanent dentition has erupted.

ECONOMIC AND COST-EFFECTIVENESS EVALUATIONS

To assess the economic literature pertaining to the costs and burdens associated with malocclusion, two of us (B.W.B., S.H.M.) conducted a literature search using PubMed, Google Scholar, Medscape, the National Health Service Economic Evaluation Database and ScienceDirect. Our search focused on the following key words: "malocclusion," "cost," "cost-effectiveness," "occlusion," "Medicaid" and "orthodontics." We grouped these terms together in various forms and reviewed the resulting list of article titles and abstracts to determine their relevance for our subpopulation of interest (that is, children enrolled in Medicaid). Through this process, we determined that 15 articles were related to the cost-effectiveness of orthodontic care or to malocclusion specifically. On further review, we considered eight³⁰⁻³⁷ of these 15 articles to be most relevant and included them in our summary (Table 1).

The economic burden of malocclusion affects patients and their families. Along with the direct cost of orthodontic care, there are indirect costs, including work and school absences and productivity loss, as well as QOL and psychological effects that can reduce OHQOL. The cost-effectiveness of early interceptive treatment of malocclusions, to our knowledge, has not been compared with that of the more prevalent comprehensive treatment performed during adolescence when patients have their full permanent dentition. Interceptive approaches to malocclusion treatment are less complicated and less costly than comprehensive approaches, but often they do not result in comparable dental outcomes. Patients with good insurance coverage or those whose families are paying out of pocket are most likely to undergo a second phase of treatment. Mavreas and Melsen³⁸ reported that the trade-off favored interceptive treatment, but researchers have not conducted systematic analyses of the factors that might influence outcomes.

In a study conducted in the United Kingdom, O'Brien and colleagues³⁵ focused on the cost differences between one- and two-phase treatment. They included costs to the family associated with clinical visits and travel based on national averages, and they used the Peer Assessment Rating^{39,40} (PAR)

TABLE 1

Summary of malocclusion-related economic literature.					
SOURCE, YEAR	QUESTION/ TOPIC OF INTEREST	MAIN FINDING	DID AUTHORS ADDRESS COSTS?	DID AUTHORS ADDRESS HEALTH CARE OUTCOMES?	STUDY LIMITATIONS
Bernas and Colleagues,³⁰ 2007	Evaluate effectiveness of early phase I orthodontic treatment using the PAR* index	Phase I treatment reduced PAR index score by mean of 14.9 points (50.2 percent improvement); more than one-half of patients did not need phase II treatment after phase I treatment	Yes: mean cost of \$381 for phase I treatment	Yes: used PAR index to assess improvement	Only PAR used
Deans and Colleagues,³¹ 2009	What is the cost-effectiveness of orthodontic care and how can it be measured?	Costs vary greatly across countries, but ICON† is a reliable orthodontic index that can be used in cost-effectiveness studies	Yes: direct treatment costs were measured as the fees associated with dental care	Yes: used ICON score to assess improvement in oral health	Assessment done in several European countries
Dickens and Colleagues,³² 2008	Compare results for Medicaid-enrolled patients treated in private practice with results for non-Medicaid-enrolled orthodontic patients	No clinically important differences observed between the two groups	No	Yes: used PAR index to judge patients' improvement	Data based on small sample in North Carolina (nine of 55 practices that provided Medicaid-reimbursed care participated)
El-Gheriani and Colleagues,³³ 2007	Determine availability of Medicaid-funded orthodontic treatment in the 50 states	Wide variation in survey responses regarding Medicaid policies among states; no statistically significant differences identified in coverage policies, on the basis of the level of payments in state groupings	Yes: investigators gathered costs associated with state Medicaid reimbursement	No	Data only from orthodontists who participated in Medicaid program
Mirabelli and Colleagues,³⁴ 2005	Compare effectiveness of early orthodontic treatment in children enrolled in Medicaid and those covered by private insurance	Patients enrolled in Medicaid and those with private insurance scored similarly on the PAR index and ICON	No	Yes: children evaluated on basis of both PAR index and ICON	Study conducted exclusively in Seattle, results may not be generalizable and study focused only on early treatment
O'Brien and Colleagues,³⁵ 2009	Evaluate effectiveness of early orthodontic treatment with the twin-block appliance for the treatment of Class II Division 1 malocclusion	No differences observed between those who received two-phase treatment and those who received phase II treatment only in adolescence	Yes: mean cost of dental visits and travel costs included	Yes: used PAR index with United Kingdom weights; self-esteem measured with Piers-Harris Children's Self-Concept Scale ⁴¹	Conducted in United Kingdom; travel cost approach limited; only factor considered was patient's time, not parent's time
Okunseri and Colleagues,³⁶ 2007	Measure orthodontic care utilization and access to care for minority populations	Black and Hispanic children, lower-income children and those without private health insurance were less likely to report having had an orthodontic visit	No	Yes: addressed the effect that race and socioeconomic status have on orthodontic visits	Not applicable
Theis and Colleagues,³⁷ 2005	Does phase I treatment reduce malocclusion severity to the extent that eligibility for subsequent Medicaid-funded treatment is reduced significantly?	Early interceptive treatment significantly reduces eligibility for comprehensive Medicaid-funded orthodontic treatment; HLD‡ index is useful for determining Medicaid eligibility	No	Yes: eligibility for study determined by using HLD index and ICON	Investigators found that ICON tended to overestimate need; HLD was a better evaluation index

* PAR: Peer Assessment Rating.^{39,40}

† ICON: Index of Complexity, Outcome and Need.⁴²

‡ HLD: Handicapping Labiolingual Deviation.⁴³

index to assess patients' improvement in oral health. In addition, the authors assessed the children's self-esteem and the psychological burden of malocclusion by administering the Piers-Harris Children's Self-Concept Scale⁴¹ before and after treatment. The study findings illustrate the greater burden associated with two-phase treatment than with single-phase treatment in adolescence.

Deans and colleagues³¹ explored the cost-effectiveness of orthodontic treatment in several European countries and found that costs varied substantially among countries. They aimed to show that reasonably simple approaches could be used to assess the incremental cost-effectiveness of orthodontic practitioners (that is, differences in the cost of achieving an improvement in patient outcomes [benefit] by different practitioners). Their analysis was based on the differences between countries in relation to changes in patients' clinical conditions and the cost of care.

In a small sample of practitioners in seven countries, they used the Index of Complexity, Outcome and Need (ICON)⁴² to assess treatment needs and outcomes. As Deans and colleagues³¹ pointed out, the ICON assesses dental appearance through the evaluation of "dental aesthetics, crossbites, anterior vertical relationship, upper anterior crowding, and buccal segment relationships." They found that the median cost (in euros) per ICON unit reduction (that is, the cost to achieve an improvement in the ICON score) ranged from € 21.70 in Lithuania to € 116.62 in Slovenia, with a median cost of € 57.69 (approximately \$74). They concluded that researchers can use cost per improved ICON score⁴² as a measure of cost-effectiveness. Their study, although European based, may be relevant to U.S. studies that involve the use of these types of measures.

Investigators in several U.S. studies have evaluated Medicaid reimbursement with regard to malocclusion. Okunseri and colleagues³⁶ explored the relationship between orthodontic care and racial and socioeconomic factors. They found that men, blacks and Hispanics, as well as children from low-income families, were less likely to receive care despite their clinical need. Furthermore, these authors noted that recipients of Medicaid or other public insurance had fewer orthodontist visits compared with children who had private insurance coverage. Medicaid payment for orthodontic treatment depends generally on the severity of the case and on individual state policies. Administrators of Medicaid programs

evaluate severity according to various rating systems such as PAR^{39,40} and ICON.⁴² Several studies have focused on these rating systems.

Mirabelli and colleagues³⁴ explored the relationship between malocclusion improvement and the patient population. They found that patients who received Medicaid funding and those who had private insurance experienced similar reductions in PAR and ICON scores after early orthodontic treatment. These study results demonstrate that patients enrolled in Medicaid can experience the same level of improvement from interceptive care as do patients covered by private insurance. Dickens and colleagues³² evaluated a small sample of orthodontic service providers in North Carolina who administered orthodontic treatment to patients covered by Medicaid. Using the PAR index, they found that "Medicaid and non-Medicaid [eligible] patients did not differ substantially with respect to effectiveness of treatment received or their compliance with treatment."³²

Theis and colleagues³⁷ used the Handicapping Labiolingual Deviation (HLD) index,⁴³ as applied in Washington state, to evaluate medical necessity for Medicaid-funded orthodontic treatment. For patients enrolled in Medicaid, medical necessity generally determines coverage eligibility. These authors found that patients' need for a second phase of treatment, as defined by the HLD, was reduced by 62 percent after they underwent an interventional first phase. An ongoing randomized clinical trial²⁹ has confirmed this finding.

From the perspective of a Medicaid payer, all other things being equal, reduced eligibility for comprehensive care lowers total expenditures per patient. However, we found no studies that evaluated the long-term costs and health care outcomes for patients who received only early intervention. Bernas and colleagues³⁰ focused on the effectiveness of early orthodontic treatment by using the PAR index. They found that treatment resulted in a 14.9-point reduction in PAR scores (or a 50.2 percent improvement in PAR scores). The results of this study provide further evidence that early intervention is an effective initial treatment for malocclusion. The researchers, however, did not discuss the cost-effectiveness of this treatment approach.

STATE POLICIES AND HEALTH CARE PROVIDERS' PERSPECTIVES

A key component of comprehensive economic assessments is the consideration of multiple per-

spectives and stakeholders. For example, regional variability in treatment patterns or Medicaid policy restrictions may affect patient care and outcomes. Figure 1 is a health care balance triangle highlighting three crucial considerations for care: access, quality and costs/benefits.^{44,45} Health care providers have specific goals and objectives; payers and reimbursement agencies develop policies based on costs, quality and access considerations; and patients and families have distinct interests that also deserve to be taken into account by clinicians, researchers and policy-makers. Treatment and Medicaid coverage policies should include consideration of similarities and differences in stakeholders' incentives to promote reasonable access to high-quality care while attempting to manage costs.

Differences in state-sponsored programs.

People enrolled in Medicaid have a higher relative burden associated with malocclusion and more dental problems in general. Although no evidence exists of variation in the prevalence of malocclusion across the country, states differ greatly in their Medicaid policies regarding coverage and reimbursement for orthodontic services. Several states provide no orthodontic benefits. A comparison of benefits in Washington,⁴⁶ Florida⁴⁷ and New York⁴⁸ illustrates these differences.

Washington allows early intervention, comprehensive care or both with prior authorizations when a patient meets specific inclusion criteria or if he or she receives 30 or more points on the HLD index.⁴⁶ The state's Medicaid program will fund a second phase of treatment in cases in which a patient meets eligibility requirements after an interceptive treatment phase. Although New York also requires prior authorization, the state has a more liberal approach, granting considerable leeway to health care providers but requiring them to undergo an annual review. New York also allows a second phase of treatment after interceptive care if the need persists (George Cisneros, MS, DMD, chair, Department of Orthodontics, New York University College of Dentistry, New York City, written communication, Oct. 12, 2009).

Like Washington, Florida uses the HLD index with the same inclusion criteria, except that the state excludes anterior crossbite with recession. However, the program has a lower, more lenient cutoff point (26 points) for patients who do not meet these criteria. The state's Medicaid program will fund only one round of treatment, placing the provider in the position of having to decide

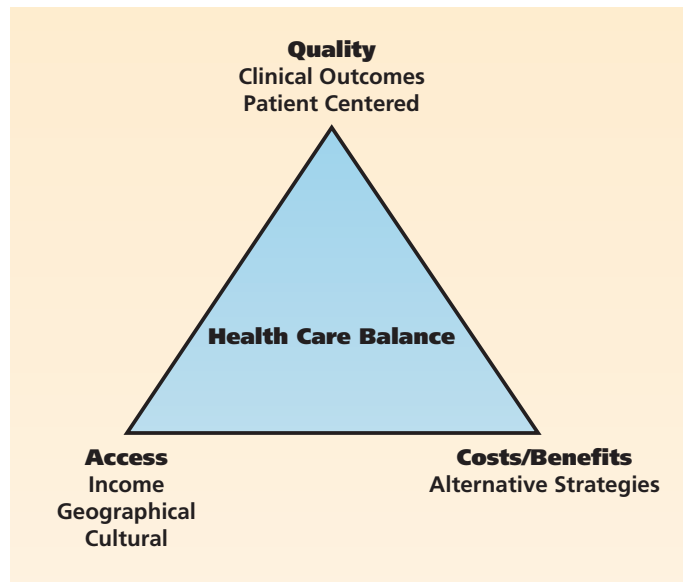


Figure 1. Health care balance triangle consisting of access, quality and costs/benefits.^{44,45}

whether interceptive or comprehensive treatment is in the patient's best interests (Timothy Wheeler, DMD, PhD, chair, Department of Orthodontics, College of Dentistry, University of Florida, Gainesville, written communication, Oct. 13, 2009).

In 2006, El-Gheriani and colleagues³³ administered a 10-question survey to the dental services section of each state's Medicaid office to assess the accessibility of Medicaid funds for orthodontic treatment. They found wide variations between states in their responses to questions relating to coverage and reimbursement policies. In their main analysis, they categorized states into three groups (highest-fee, midrange-fee and lowest-fee states). Their findings showed a lack of consistency within groups regarding Medicaid policy structure. In addition, they found no statistically significant differences between the groups with respect to survey responses (using Pearson χ^2 test, $P < .05$ threshold) concerning state requirements for determining Medicaid eligibility criteria. Examples of survey topics were the types of providers eligible for Medicaid reimbursement, the maximum age for eligibility for orthodontic services, and whether an index is used to measure handicapping malocclusion or frequency or type of payment to providers. Survey respondents included orthodontists treating Medicaid-enrolled patients, and the investigators gathered cost and reimbursement data from all 50 states. A regional analysis suggested that Medicaid reimbursement for orthodontic care was 26 to 50 percent lower

TABLE 2

Stakeholders' considerations regarding malocclusion correction under Medicaid during mixed-dentition stage.

VARIABLE	PATIENT	PARENT	HEALTH CARE PROVIDER	MEDICAID
Potential Burdens of Malocclusion	Reduced oral health-related quality of life (OHQOL), poor body image, lowered self-esteem, discomfort; perceived and actual limitations on social opportunities	Frustration with being unable to afford high-quality treatment for their child; psychological burden associated with teasing of their child; worries about risk of dental injury	Unmet opportunities to reduce malocclusion severity; may not be able to provide satisfactory or ideal (that is, complete) treatment	Limited guidelines and clinical study evidence regarding the comparative effects of alternative malocclusion treatment strategies; must make decisions regarding disparities in access to treatment
Potential Costs of Treatment	Missed school; time and effort needed for treatment compliance; poor self-image during treatment; risks associated with treatment; oral discomfort	Time away from work; transportation costs; child care for siblings; family conflict regarding compliance; need for follow-up; loss of Medicaid eligibility for more comprehensive care	Labor for treatment time; materials; staff; overhead; forgone opportunities to treat patients not enrolled in Medicaid; practice image; poor patient compliance; risk of financial loss owing to insufficient reimbursement	Financial considerations regarding treatment alternatives (that is, interceptive treatment in mixed-dentition stage versus comprehensive treatment in permanent-dentition stage)
Potential Benefits of Treatment	Improved occlusion, appearance and OHQOL; better body image; greater knowledge of oral hygiene; improved oral comfort; enhanced self-esteem	Satisfaction with child's improvement in oral health; reduction in psychological burden; less concern regarding child's treatment and oral health	Satisfaction with treatment outcome; maintenance of high-quality care and clinical responsibility	Meeting governmental mandates for providing appropriate care to disadvantaged populations; reducing unmet clinical need for oral health treatment in lower-income communities
Factors That May Affect Costs and Benefits	Severity of malocclusion; level of treatment adherence and compliance; age, sex, ethnicity; treatment complexity; family characteristics	Work status and ability to commit to treatment appointment schedule; ability to enforce child's compliance with treatment	Expertise and experience; willingness to treat patients enrolled in Medicaid; regional location within United States (for example, urban versus rural)	State-specific eligibility criteria and coverage and reimbursement policies

than reimbursement from private insurance companies.³³

Considerations for providers. Orthodontists have conflicting incentives regarding treating low-income patients with malocclusion and must balance economic and clinical decisions. As dental care providers, they want to provide high-quality care and reduce the burden associated with oral conditions. However, they generally are in private practice (versus public clinics) and must take into consideration practice management expenses. Therefore, restrictive Medicaid reimbursement policies may not provide a sufficient incentive for clinicians to administer the highest-quality, most resource-intensive care and sometimes may limit clinically appropriate care.

Orthodontists must weigh the opportunity to treat dental problems at an early stage (with some clinical benefit likely) with the possibility that patients enrolled in Medicaid may lose eligibility for more comprehensive care. Partly for reimbursement reasons and partly because of the

additional challenges in treating people from lower-income populations, there is a shortage of orthodontists who accept patients receiving Medicaid. This creates a need for innovative solutions and, possibly, for a modification of the reimbursement criteria for treating malocclusion. Missed appointments also can affect orthodontists' willingness to treat patients from lower-income households. Mirabelli and colleagues³⁴ reported that Medicaid-enrolled patients in Seattle missed significantly more appointments and had poorer oral hygiene than did other patients, although treatment outcomes did not appear to be affected by these factors, as measured according to two indexes.

CONCEPTUAL FRAMEWORK FOR ECONOMIC EVALUATIONS OF TREATMENT

An initial step in any economic analysis is to identify the relevant parameters for assessing a particular perspective, such as that of Medicaid payers, health care providers, the patient's family

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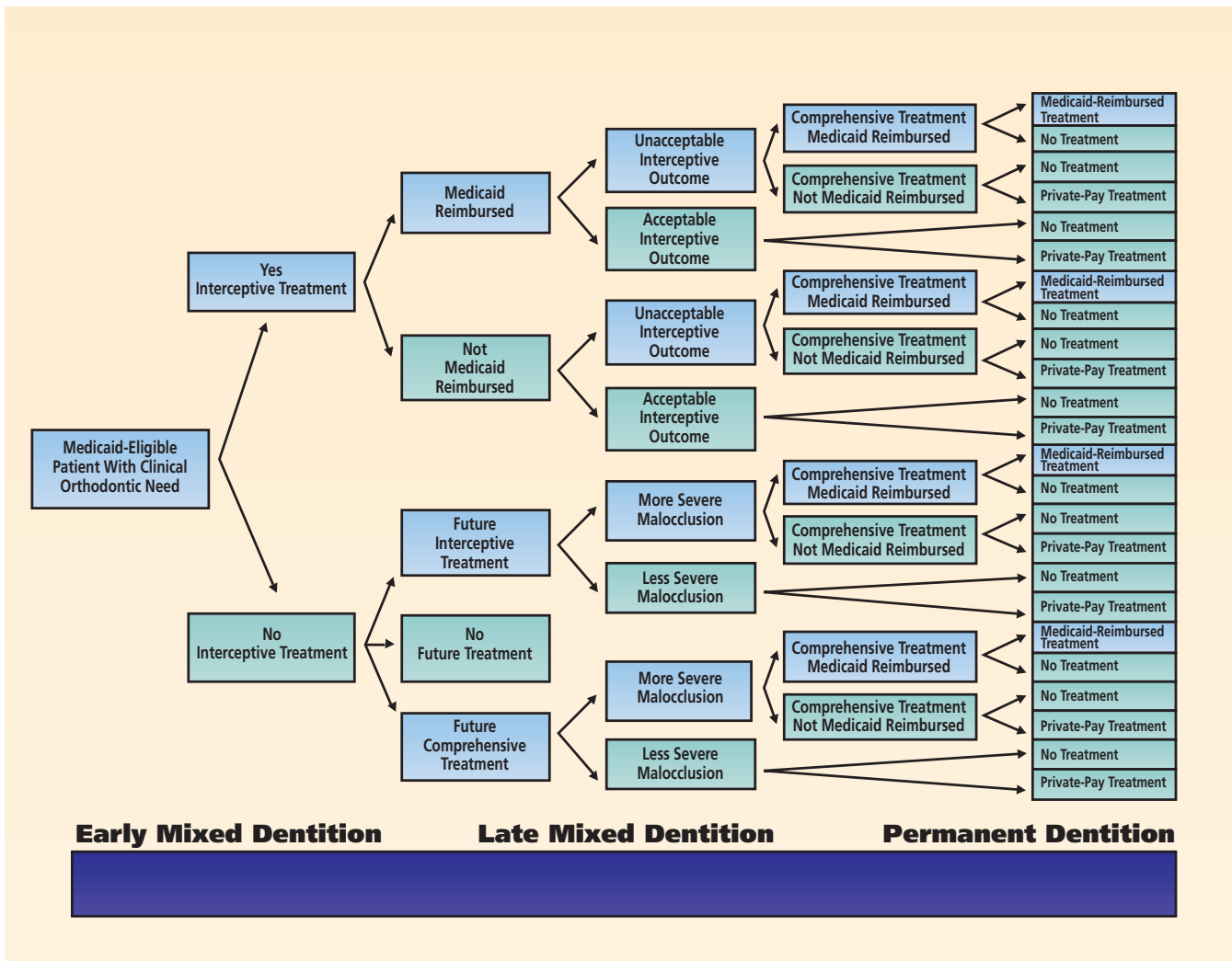


Figure 2. Decision tree for Medicaid-eligible patients who have a malocclusion and are in the early mixed-dentition stage.

or society as a whole. Table 2 presents a list of considerations for patients, their parents, providers and Medicaid programs.

Figure 2 depicts a simplified decision process (that is, a decision tree) that can be used as a framework to evaluate the costs and effects of treating or not treating malocclusion in patients enrolled in Medicaid. The figure represents the essential elements of the decision-making process that health care providers and patients go through when determining whether to begin interceptive orthodontic treatment within the Medicaid program. In an empirical analysis, investigators typically would include probabilities, health effects, costs or a combination of these associated with each branch of the decision tree.

Our model framework provides one representation of treatment decisions related to malocclusion,

although there may be other ways for health care providers and families to evaluate these issues. We would expect their choices to be influenced by the coverage and reimbursement policies of the Medicaid programs in their states. To study the range and effect of malocclusion severity, we need to consider variables such as age, sex, ethnicity, pretreatment QOL and expected levels of treatment compliance. Each factor can influence clinical success and health outcomes and, in turn, the cost-effectiveness of different orthodontic intervention strategies.

Researchers can use the results of clinical studies as parameter estimates (for example, the degree of change in occlusion) in a cost-effectiveness analysis. A comprehensive evaluation should include the effect of malocclusion and its treatment on patients' OHQOL. It is important to describe

and quantify potential socialization deficits and mental health effects on children and teenagers with facial features that are considered abnormal. Investigators can assess the responsiveness of patients to interceptive and comprehensive treatments determined via standard dental measures, such as PAR and ICON, in relation to treatment costs. Economic evaluations should include comparisons of alternative measures and determine the consistency and sensitivity of the measures used to assess clinical and economic outcomes.

DISCUSSION

Malocclusion imposes a larger relative burden on low-income groups than on higher-income groups. We have reviewed the issues associated with the condition as they pertain to the Medicaid population and the reimbursement environment. In addition, low-income families, who tend to work in hourly-wage jobs, must consider the time (an indicator of cost) involved in obtaining treatment. These families experience additional challenges, such as obtaining reliable transportation, getting time off from less flexible jobs and day care costs for siblings during appointments. Many of these families live in rural areas where access to orthodontic treatment often is limited.

In contrast, most states put orthodontic care for patients with cleft lip and palate and those with craniofacial anomalies in a high-priority category with respect to funding.⁴⁶ Moreover, because these problems usually are recognized at birth and the treatments are complex, these patients receive early guidance from specialized multidisciplinary teams of health care providers. These teams coordinate care and provide follow-up throughout the developmental years. Although these patients also face access issues, they usually do not rise to the same level as those of otherwise healthy children with malocclusions for which treatment is considered medically necessary, primarily because the funding criteria for the latter often are more restrictive and there is little coordination of referrals or follow-up for these patients.

The literature regarding the cost-effectiveness of malocclusion treatment is quite limited. To our knowledge, there are no published studies that link the payer's (that is, Medicaid's) and orthodontists' incentives with patients' and families' concerns and patients' well-being. Clinically, the opportunity exists to reduce the severity of malocclusion by providing early intervention. However, given current Medicaid reimbursement restric-

tions, comprehensive care in many states requires that patients have a severe malocclusion to be eligible for treatment. Thus, orthodontists and patients often are faced with a difficult decision: should they opt for earlier care to prevent a worsening of the condition and possibly attain a modest improvement, even though doing so may jeopardize the patient's eligibility for subsequent comprehensive treatment through Medicaid? The dental profession faces financial and time constraints associated with low reimbursement for treatment of patients with more severe dental problems requiring a higher number of, and more intensive, office visits.

Teaching institutions and state agencies should collaborate to develop innovative solutions to reduce disparities experienced by patients enrolled in Medicaid. For example, they could develop a program to allow orthodontic residents or recent dental school graduates to provide these services in exchange for a reduction in their dental school debt. By connecting specialists with general dentists, teledentistry can facilitate the transfer of specialized expertise to those providing general dental services, which may be particularly beneficial for Medicaid recipients in rural settings.⁴⁹ Another option is conditional reimbursement for subsequent comprehensive care predicated on patients' maintaining a reasonable level of adherence to treatment regimens during earlier interceptive therapy.

Third-party payers are searching for methods to improve the value delivered for the reimbursed dollar. Strategies that motivate patients to make stronger commitments to their treatment plans (such as keeping all appointments) may help generate improved dental care outcomes and provide more cost-effective solutions. Such strategies also may persuade more orthodontists to become Medicaid providers.

In addition, orthodontists in private practice and professional organizations can introduce solutions (such as shorter treatment time) to reduce the clinical, psychological and economic burden of malocclusion on lower-income patients. It would be helpful to establish a framework for instituting changes in dental care policy to address the issue of social responsibility for these patients. Ideally, the implementation of health care policy changes should be based on research findings. This is a challenging mission, but it can be accomplished by incorporating combinations of the following strategies:

- encouraging active and retired orthodontists to provide some pro bono care;
- advocating for community clinics to provide orthodontic care;
- expanding referral networks in each community;
- advocating for policy changes in Medicaid that can improve access to orthodontic care;
- emphasizing social responsibility in dental and residency curricula;
- encouraging study clubs to discuss health care disparities and the need for policy changes, with speakers from universities and government agencies providing background for discussion.

Additional economic and cost-effectiveness assessments would contribute to a more extensive understanding of the multiple issues involved in patient care, such as patients' emotional health, self-esteem and dental care-related well-being, direct and indirect costs, as well as the effect of private and public payer policies related to malocclusion. Our assessment of malocclusion in lower-income patients has raised conceptual considerations for this segment of the U.S. population and for orthodontists who treat them. Further evaluation of the burden of malocclusion and its treatment is needed from a clinical, economic and health care policy perspective, particularly for patients enrolled in Medicaid.

CONCLUSION

We have assessed the QOL and economic issues associated with the burden of malocclusion on patients, families, health care providers and Medicaid payers. In summarizing the literature and providing a conceptual framework for analyzing cost-effectiveness, we have laid the groundwork for additional quantitative evaluations of treatment and outcomes. A comprehensive analysis should include consideration of the relationships among Medicaid reimbursement policies and standards, incentives for dental care professionals to provide high-quality care to lower-income patients, costs and challenges of achieving good dental outcomes through an assessment of alternative treatment options, and issues pertaining to health care access in subpopulations experiencing health care disparities. ■

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