Mission

THE JOURNAL OF THE AMERICAN COLLEGE OF DENTISTS shall identify and place before the Fellows, the profession, and other parties of interest those issues that affect dentistry and oral health. All readers should be challenged by the Journal to remain informed, inquire actively, and participate in the formulation of public policy and personal leadership to advance the purposes and objectives of the College. The Journal is not a political vehicle and does not intentionally promote specific views at the expense of others. The views and opinions expressed herein do not necessarily represent those of the American College of Dentists or its Fellows.

Objectives of the American College of Dentists

THE AMERICAN COLLEGE OF DENTISTS, in order to promote the highest ideals in health care, advance the standards and efficiency of dentistry, develop good human relations and understanding, and extend the benefits of dental health to the greatest number, declares and adopts the following principles and ideals as ways and means for the attainment of these goals.

A. To urge the extension and improvement of measures for the control and prevention of oral disorders;

B. To encourage qualified persons to consider a career in dentistry so that dental health services will be available to all and to urge broad preparation for such a career at all educational levels;

C. To encourage graduate studies and continuing educational efforts by dentists and auxiliaries;

D. To encourage, stimulate and promote research;

E. To improve the public understanding and appreciation of oral health service and its importance to the optimum health of the patient;

F. To encourage the free exchange of ideas and experiences in the interest of better service to the patient;

G. To cooperate with other groups for the advancement of interprofessional relationships in the interest of the public;

H. To make visible to professional persons the extent of their responsibilities to the community as well as to the field of health service and to urge the acceptance of them;

I. To encourage individuals to further these objectives, and to recognize meritorious achievements and the potentials for contributions to dental science, art, education, literature, human relations or other areas which contribute to human welfare—by conferring Fellowship in the College on those persons properly selected for such honor.
Future of Dentistry

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Snowballs in Hell
Measured Success
Donald Schönb, who devoted his life to studying the way professionals learn, was fond of pointing out that professionals value consistency over creativity. He used the example of airlines pilots, who are expected to land their planes safely and on time but get no bonus points for fancy tactics in the process. Consistency in professional practice means making sure the probability of unwanted outcomes is predictably below critical values. There should be "a snowball's chance in hell of making a mistake."

In the interests of integrity in journalism, it is necessary for me to make the disclosure that this editorial is about statistics. It will even include formulas. Before you flip to the next page, let me hasten to point out that the ideas presented here were developed while I was visiting at 3707 North Canyon Road in Provo, Utah; that the calculations can be done with a paper and pencil, from data commonly reported in the literature; and that the results estimate the likelihood of practicing without making a mistake in one's lifetime.

Here is the problem. You are considering switching to a new impression material because the advertisements say it is "fast." An alternative whiting system promises to produce a two-shade change in one application. A bonding agent is better than a control comparison in a clinical test at \( p < .001 \). Such claims are common, but a little vague and not up to the professional standard of making unwanted outcomes less likely than the survival rate of snowballs in hell. Even when details are provided in the literature or the documentation that accompanies materials, it is not apparent how to evaluate the likely outcomes in one's own hands.

Advances have been made in applying rigorous experimental design and statistical analysis techniques to product development and testing and in the standards for scientific reporting and advertising. But the problem cannot be solved from that end. The reason is simple. Scientists and manufacturers do not know how the products will be used in your office; and your demands on products may very possibly be different from your colleagues' expectations.

Maximizing the benefit from product information requires cooperation between those who develop and test innovations and those who use them. Neither party should delegate their responsibility.

The minimal requirement for a practitioner is to use only those technologies that have an acceptably small likelihood of adverse outcomes in their practices. This editorial shows how to calculate that likelihood from data that are typically available in the literature and in promotional material.

Three pieces of information are required. First we must know the general level of performance of the technology: this is conventionally reported as the mean or average result. Next we need to know something about the variability of the results. Absolutely all processes have some degree of natural variability.
inherent in them. Variability is typically reported in the literature as “standard deviation,” abbreviated SD or often shown in parentheses following or below the reported mean. Small standard deviations result in greater predictability in the outcomes. All scientific literature and many promotional pieces routinely report means and standard deviations. (Statistical tests comparing new technologies against controls always use such information.)

The third, and more likely missing, piece of information can only be provided by the practitioner. We must have some standard; some reasonably consistent idea of what is good enough for each dentist’s particular requirements. (I will explain later why it is self-deluding to hide behind the open-ended standard of “always use the best” and dangerous to hope that somebody else will decide what is good enough.)

For the sake of example, let’s assume that a dentist has set a personal standard for speed of impressions of two minutes, for whitening at one shade for each of the first three appointments, and bonding at 15 MPa. The bonding standard was determined by general satisfaction with the current materials that report an effective strength in this range and from talking with colleagues. The issue is not whether these or similar standards are “right.” They are the standards the dentist in our example chooses to base his or her reputation and satisfaction in practice on.

It should be obvious that the mean performance of the technology should be better than the standard set by the dentist for its use. If the dentist uses an impression material with an average working time of two minutes and expects to get an impression in two minutes, he or she will be disappointed about half the time (assuming a normal distribution of outcomes). The typical performance of usable technology should always be better than the standard for its use. But how much better? The answer to this is buried in the standard deviation, the measure of variation naturally inherent in all processes. Systems with small standard deviations will have small likelihood of producing extreme (unfavorable) outcomes. Practitioners need processes that perform (on average) well above their personal standard or have tight (small) standard deviations to reduce the chances of extreme values, or both.

Dentists who are willing to express their practice standards in quantitative form can project the chances of unexpected outcomes since means and standard deviations are typically available in the literature. The calculation is simple enough to perform by longhand. First find the difference between the average performance of the technology and the practice standard. In our example, we might assume that the dentist wants a standard bonding strength of 15 MPa and uses a product with an average of 17. The safety buffer is 2 MPa. To find out how sensitive this buffer is to variation in the technology, we divide it by the standard deviation. In our example, we could assume that somewhere in the packing material that came with the adhesive, it is reported that average = 17.0 (±1.0). The arithmetic is simple: (17 - 15) / 1 = 2.0. This statistic is customarily abbreviated with the symbol “z,” but it could easily be thought of as the “practice risk factor” or the chances of a snowball surviving in hell.

Although z is a universally recognized statistic, some help is needed to make it useful in the practice setting. That help is provided in the accompanying table. Using the table it is possible to convert z to the likelihood of an unwanted outcome happening in practice. The middle column shows the probable number of failures during one year for representative values of z (based on the assumption that the procedure is used once each day and the dentist practices five ways per week for forty-eight weeks in the year). Our hypothetical dentist who uses the bonding agent with an average of 17 MPa of strength because he or she only needs 15 will be disappointed about five and a half times each year. A z-value of 2 is probably not acceptable for most dentists.

To show how the practice risk factor can be applied to potential decisions, consider two alternative bonding agents. One of them, Product X, reports a mean strength of 20 MPa with a standard deviation of 2. That is an improvement: z = (20 - 15) / 2 = 2.5. The expected number of failures per year has been reduced to about one and a half. But what about an al-

<table>
<thead>
<tr>
<th>Table. Practice Risk Factor, Z.</th>
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<tr>
<td>Z</td>
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</tr>
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Failures per year and time to first failure are estimated based on probability of using the technology once each day, five days each week, forty-eight weeks per year.
ternative, Product Y, with an average strength of 20 and a standard deviation of 1 (same average strength but much more predictable results)? Now the risk to the practice is $z = 5.0$, or seven thousandths per year if used every day. This shows how important it is to look at both average performance and variation in making a product choice.

The table also shows, in the third column, the effect of practice risk factor on length of time to first failure. The product currently used by our hypothetical dentist will fail every forty-five days. Product X with mean 20 and SD 2 for $z = 2.5$ will fail about every five months. But Product Y, the one with the same average strength but a smaller variation, and $z = 5.0$, will fail about once in 14,500 years if used every day. That is pretty much a lifetime guarantee.

Practitioners need processes that perform (on average) well above their personal standard or have tight (small) standard deviations to reduce the chances of extreme values, or both.

Some marketing claims and some research results can be misleading when they make a claim about being “better than a control product.” A bonding agent with a mean strength of 30 and a standard deviation of 2, Product Z, would be “better by far” than any we have discussed. The practice risk factor, $z$, would be 7.5, and the product would not be expected to fail (as a result of characteristics of the material itself) until one and a quarter billion years, give or take. That is certainly impressive, but it is also a bit silly. What is the difference between failing once is a billion years and once in fifteen thousand? I would not pay my accountant good money to research this kind of difference—I would be expecting him to be engaged in things that mattered more.

The practice risk factor can be used as a practical guide to what is “good enough.” Dentists would be regarded as very reasonable if they used materials that were not likely to fail once over the life of their practices. This is about $z = 3.5$ or 12 years for most technologies. If they demanded a higher level of assurance, they might be thought a bit fastidious. They might also be suspected of being unwise in the allocation of their attention. If two technologies both pass the “good enough” test—are unlikely to fail at all during the practice lifetime—the less expensive, or the more esthetic, or the more easily used one should be chosen. Computing the practice risk factor can be a practical guide for deciding when to switch from one criterion to another in evaluating technology.

This is a convenient point to reintroduce the notion of trying to avoid the decision about whether a technology is acceptable by saying “I always use the best.” In the first place, the best may not be good enough. Some lasers are better than others for cutting hard tissue. But none are currently good enough—the best do not meet most dentists’ standards. Even among those technologies that meet standard, dentists do not always choose the best. Honest dentists admit that they have not spent the maximum amount of time with every patient. Routinely dentists trade what is good enough on one dimension of the complex practice of dentistry to achieve some preferred blend of outcomes.

The elements for computing practice risk factor are typically available to dentists for many procedures and technologies. Of the three (average, standard deviation, and standard), the one dentists have to provide typically proves to be hardest to pinpoint and the one that gives dentists the most headache. Some practitioners are so concerned about anyone else looking at the quality of their results, that they protect the privacy of outcomes even from themselves.

Many dentists are intuitively aware that the technologies they use in their offices need to be better on average than necessary to meet their personal standards and that predictable technologies are highly prized. All dentists I know have a sense of what is good enough and are unwilling to simultaneously pursue perfection on multiple fronts. Even if they don’t whip out their calculators when they see an ad for a new product to figure whether the margin of safety is three and a half times the standard deviation of the process, they are generally aware of the concept and understand the fate of snowballs in hell.
The Future of the Dental Profession: Research, Education, and Practice in the New HealthCare Environment

Ira B. Lamster, DDS, MMSc, FACP

It is a pleasure for me to provide a brief introduction to the proceedings of this symposium. This one-day meeting held at the Columbia University School of Dental and Oral Surgery attracted more than one hundred attendees, and very lively discussion followed the presentations.

The dental profession finds itself at a most interesting and challenging time. The release of the Surgeon General's report on oral health (Oral Health in America: A Report of the Surgeon General) and the Future of Dentistry report prepared by the American Dental Association raised many important issues for the profession. Representatives of the practice community and organized dentistry, the dental schools, the National Institute of Dental and Craniofacial Research, and the dental manufacturing industry must begin a dialogue to address issues such as oral health disparities in the United States; the financial challenges faced by dental schools and the need to focus on research relevant to oral health; and the profession's position in the greater context of the health care environment.

The stakeholders do not exist in a vacuum, and their actions are influenced by, and influence, one another. The challenges facing the profession, therefore, can best be managed when the interested and involved parties join together to identify common concerns and proceed to develop coordinated responses. The presenters at this symposium are leaders in our profession, representing the research, education, development of the next generation of dental school faculty; the size and diversity of the workforce; support for basic translational, clinical, and health services policy, and practice communities. Their comments are thoughtful, useful, and occasionally controversial. We hope that these proceedings serve as a stimulus for further discussion and ultimately the development of strategies to address challenges that face the profession.

This symposium was made possible by an unrestricted grant from Procter & Gamble, and I want to thank them for their willingness to invest in this look at the future of the profession. Procter & Gamble and Michael Sudzina are partners in our effort to move the profession forward.

Ira B. Lamster is Professor of Dentistry and Dean, Columbia University School of Dental and Oral Surgery.

Dushanka V. Kleinman, DDS, MscD, FACD

Abstract

"The intent of this first-ever Surgeon General's Report on Oral Health is to alert Americans to the full meaning of oral health and its importance to general health and well-being" (US Department of Health and Human Services, 2000). Thus began the introductory message from the Secretary for Health and Human Services to Oral Health in America: A Report of the Surgeon General, released in May 2000. The centerpiece of the charge was to "define, describe, and evaluate the interaction between oral health and general health and well-being through the life span in the context of changes in society" (US Department of Health and Human Services, 2000). To address this charge, the report was science-based, prevention and health promotion-oriented, and focused on all life stages. Although the report stressed oral health, not the dental profession, the report's messages and themes are relevant to current and future dental practice, education, research, and to dentistry's role in the healthcare system.

The Report's Major Message and Themes

The major message of the report is that "oral health is essential to the general health and well-being of all Americans and that improved oral health can be achieved by all Americans." However, the major message also highlights that although the oral health status of our nation has improved, not all segments of the population have participated in these gains (Figure 1).

The major message was bolstered by several themes, not new to those in the dental profession, that have relevance to the future of the dental profession.

Theme: Oral Health Means Much More Than Healthy Teeth.

The report informed the public, health professions, and policy-makers of the extensive nature of conditions and disorders that affect the craniofacial complex and its optimum functioning. The report also projected a more complex picture of the nation's future oral health due to projected changes of the racial, ethnic, and age distribution of our population, the anticipated trends in oral diseases and conditions and in lifestyle behaviors, and the public's ready access to the rapidly expanding increase in health-related information, among other factors. Oral diseases are complex, they involve an interplay of environment, behavior, and genetic factors. Individuals are susceptible to these diseases at all stages of life.

These facts require a dental profession that gives visibility to the broad range of oral diseases, conditions, and...
their functions; is competent to address them; and is proactive and visible in designing programs to address these conditions. Dentistry’s ability to integrate dental care with other aspects of health care for the full range of conditions—from birth defects to oral cancer—is of key importance to the future of the profession.

**Theme: Oral Health Is Integral to General Health.** The report emphasized the importance of the mouth as part of the body, stressing that the craniofacial complex reflects general health and well-being. Our current health care system isolates the care of the mouth from the care of the rest of the body. The report emphasized the critical role of eating, speaking, and other functions to growth and development and to quality of life; described the existing and emerging relationship of oral infections to systemic conditions; and highlighted the social impact of oral diseases on time lost from work, school, and other factors affecting the nation’s economic welfare. The report also stressed the diagnostic potential of the craniofacial tissues and fluids, such as saliva; the mouth as a portal of entry for infections; and the role of the oral mucosal immune system as a main line of defense against toxins and pathogens.

The dental profession is key to informing and working closely with other health care providers to integrate oral health promotion, disease prevention, and early detection into general health care. The relationship of periodontal infections to low-birth weight and premature babies and the oral health effects of uncontrolled diabetes are but a few of the examples that create an imperative for a closer relationship between the dental and other health care professions. The future will require a dental profession that acts on the basis of diagnostic data and is reimbursed for these diagnostic assessments, routinely interacts with the broader health professions community, is well-versed in complex medical problems, and is primed to appropriately adopt relevant science-based findings. This will require extended efforts in oral health research and in the continual updating of dental school curricula and continuing education courses as the science evolves.

**Theme: Safe and Effective Disease Prevention Measures Exist that Everyone Can Adopt to Improve Oral Health and Prevent Disease.** The report celebrated the existence and effectiveness of dental caries prevention methods, specifically those of fluorides and dental sealants, but acknowledged that preventive measures for other conditions are not well developed. However, for all oral diseases, the report called for further development of biomedical and behavioral approaches to disease prevention and for health promotion. The report highlighted the complexity of oral disease control and emphasized that concurrent efforts are needed on the part of individuals, practitioners, and the community. Prevention is the dental profession’s legacy. To further improve the nation’s health, the dental profession will need to garner more aggressive efforts to extend the existing preventive measures to underserved populations and will need to be more active in the development and implementation of preventive programs for other conditions, such as oral cancer.

**Theme: General Risk Factors Also Affect Oral and Craniofacial Health.** The report revealed the contribution that health determinants, such as tobacco use and diet, have on oral health and on other body systems and tissues. In addition, sports-related protective practices, such as the use of mouth

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**Figure 1: Burden of Disease: Selected Highlights from the Oral Health in America: A Report of the Surgeon General.**

- Poor children suffer twice as much dental caries as their more affluent peers, and their disease is more likely to be untreated.

- Uninsured children are two and a half times less likely than insured children to receive dental care.

- A greater percentage of non-Hispanic blacks eighteen years and older have missing teeth when compared to non-Hispanic whites.

- Employed Hispanic adults were twice as likely to have untreated dental caries as non-Hispanic whites.

- Adults with incomes at or about the poverty level are twice as likely to report a dental visit in the past twelve months as those who are below the poverty level.

- The five-year oral cancer survival rate for white patients is 56% percent; for blacks, it is 34%.

- At any given time, 5% of Americans aged sixty-five and older are living in a long-term care facility where dental care is problematic.
guards and helmets, were recognized. In appropriate lifestyle behaviors can contribute to increased risk of oral diseases. Their control and prevention also require active counseling by all health professions, including dentistry. This will be a challenge, since counseling skills are not readily taught in health professions education, although most of the services recommended by the Clinical Preventive Services Task Force require counseling (U.S. Preventive Services Task Force, 1996).

The dental profession has been involved in health education of the public, primarily with a focus on hygiene practices and with initial efforts in tobacco control. To make further gains in the prevention of oral diseases, the dental profession will need to extend their future efforts into health promotion. This will require a coordinated and integrated effort with other health professions, health policy development and social service delivery.

Implications of the Report for the Future of the Dental Profession
The Surgeon General's Report provides the basis for a future for the dental profession that is more extensive and organized in its outreach to the public, more integrated with health care professions and delivery, and more involved in health policy and social services. Different orientations and approaches will need to be designed for dental practice and research in order to address these roles. Selected general approaches are offered.

The future of the dental profession is dependent upon the profession's capacity to be science-based, science-oriented, and science-involved. Science speaks to the future. We need to invigorate the approach to science conduct and harness the benefits of the scientific revolution for oral health benefit. The Surgeon General's Report calls for an acceleration of the transfer of research findings into practice as well as an increase in clinical and health services research. Increased involvement of dental schools in research conduct and in educating students in elements of research design and analysis would contribute to achieving this recommendation. Collaborative investigations among health disciplines also would benefit oral health.

The practitioner's active role in continually surveying, critically evaluating, and appropriately applying the rapidly expanding science base is key for timely science transfer. The current focus on "evidence-based dentistry" is based on using the best available external clinical evidence from systematic research together with individual clinical expertise and patient choices (Sackett et al, 1996). Criteria for systematically assessing the scientific evidence exist for both clinical and community-based programs (U.S. Preventive Services Task Force, 1996; Task Force on Community Preventive Services, 2000) and are being used by the profession. Their use needs to be expanded. Most recently, these methods have been applied to the oral health literature as part of the NIH Consensus Conference on the Diagnosis and Management of Dental Caries (NIH Consensus Development Conference on Diagnosis and Management of Dental Caries Throughout Life, 2001) and in the oral health component of the Community Preventive Services Task Force (Task Force on Community Preventive Services, 2002). These systematic assessments specify the level of evidence and highlight needed research where insufficient evidence is noted.

The time also is ripe for the practicing profession to become more science-involved. Individual practitioners play a key role in observing and documenting conditions that warrant further study. In addition, involvement of practitioner networks in the conduct of research would be an adjunct to the increasing clinical research needs and opportunities.

The future of the dental profession relies on its continued and expanded focus on disease prevention and its evolution in health promotion. Disease prevention is the mainstay of the dental profession, yet more must be done to extend these services to those who are less fortunate, who are not aware, or who are geographically isolated. Estimated expenditures for dental care in the United States in 2001 approach $64.4B (Health Care Financing Administration, 2002). The average cost of severe early childhood caries ranges from $1,500 to $2,000, depending upon whether hospitalization is needed (Griffin et al, 2000; Kanellis et al, 2000). These societal and fiscal costs do not have to occur since methods to prevent dental caries are readily available. Also, more needs to be done to develop and test preventive approaches for the many other oral diseases and conditions.

Increasing the focus on health promotion is another key role for the future of the dental profession. This role requires expanding tobacco prevention and cessation and nutrition programs. To proactively support health promotion, the dental profession will need to work to enhance the public's health literacy and science literacy; will need to work at the community level to build public policies that support health and strengthen community programs; and will need to expand its risk communication skills. Both disease prevention and health promotion require integration of services with the
The future of the dental profession rests on its ability to become population-based. By addressing the needs of population health, in addition to those of individual patients who frequent dental offices, the dental profession can increase its ability to promote health and quality of life. Information technology tools permit individual practices, dental schools, and research laboratories to become connected and function as groups. For example, by using electronic communication, developing and using teledentistry and telemedicine approaches, and by developing virtual grand rounds, dental practitioners can become aware of the larger population that surrounds them and can position themselves to serve a larger proportion of the population. In addition, the dental profession, organized and functioning in this manner, can become the base of a critically needed surveillance system, capturing unusual cases or sentinel events and reporting them centrally.

This augmented surveillance system could cement the critical partnership needed between the private practicing community and the public health system.

The dental profession is the only entity with an oral health conscience. However, even though the dental profession is the major contributor to the nation’s oral health, it is not the only entity responsible for oral health.

Indeed the private practice of dentistry is the centerpiece of the nation’s oral health public health system. The proposed system also can be used to document the many basic demographic and medical conditions that are captured in a routine exam in addition to reporting oral diseases and conditions. By functioning in this manner, together with exercising the primary care skills as a profession, dentistry can play a key role together with other health professions in addressing bioterrorism and emergency responsive-ness. Being population-based also means that the profession needs to be ready to address the oral health needs across the life span in a society with rapidly changing demographics.

The future of the dental profession depends upon its ability to take leadership for the nation’s oral health. Leading the nation will require addressing issues that reside within the dental profession that can make a major difference to oral health. Of key importance is a renewed and reinvigorated effort to recruit and support a diverse workforce. Approaches for the maximum use of human resources for oral health gains need to be developed. Provision and reimbursement for diagnostic and counseling services also is needed.

A leadership role is not new to the dental profession. The practicing profession, leadership has best been demonstrated by the efforts in disease prevention in offices and in the community. The most visible has been the support and promotion of community water fluoridation, identified as one of the top ten public health achievements of the previous century (Centers for Disease Control and Prevention, 1999). The dental research community has unveiled the basic understanding of oral and craniofacial diseases and conditions and growth and development and it has taken the lead in the development of clinical genetics. Dental researchers have provided national and international leadership in pain research, in the development of biomaterials science, and now biomimetics, and in the understanding of autoimmune disorders. The dental education community has worked to develop surrogate models for surgical technical training, incorporated community and the public health system.

By addressing the needs of population health, in addition to those of individual patients who frequent dental offices, the dental profession can increase its ability to promote health and quality of life.
Future of Dentistry

- Building effective health infrastructure that meets oral health needs;
- Removing known barriers between people and oral health services; and
- Using public-private partnerships to improve oral health.

Five listening sessions, attracting almost four hundred individuals, were held in different regions of the country to obtain input for the development of the call to action. The testimony provided through these sessions and in writing has revealed the need for short-term and long-term solutions to meet the oral health needs of the underserved and to address complex health care, research, and education needs.

As stated by Surgeon General David Satcher in the preface to the report, "To improve quality of life and eliminate health disparities demands the understanding, compassion, and will of the American people ... A framework for action that integrates oral health into overall health is critical if we are to see further gains."

Oral Health in America: A Report of the Surgeon General challenges the dental profession to contribute its expertise to a more extensive role in health care, research, education, and health policy. Integration of oral health in all aspects of health, social services, and general education is key and must be lead by the dental profession. The future of the dental profession depends upon it.

References


The Future of Dentistry: A Synopsis

Leslie W. Seldin, DDS, FACD
L. Jackson Brown, DDS, PhD, FACD

Abstract
The American Dental Association commissioned the Future of Dentistry report in 1999. A sixteen-member oversight committee and six expert panels developed the report. It was presented to the American Dental Association's House of Delegates in October 2001. The Future of Dentistry report was intended to describe the current status of the U. S. dental profession, observe trends that will influence the profession, envision challenges that the profession will confront in the next five to fifteen years, and make recommendations regarding how to meet those challenges. The report concludes that the profession is strong and healthy. Revolutionary changes are not necessary. However concerted effort to address the areas of concern is important to assure the American people access to the finest dental health care possible. This effort will require the cooperation of all involved in the dental care—the profession, industry, policy-makers and the public.

In 1999, the American Dental Association House of Delegates commissioned a project called the Future of Dentistry, establishing a sixteen-member oversight committee to create a picture of how dentistry will change in the new century. Experts from around the country provided input into the subject matter of the report and wrote the initial drafts of the chapters of the report. After soliciting and reviewing hundreds of pages of written testimony, hosting three public forums, and devoting nearly two years of work, the committee completed the report and presented it to the American Dental Association House of Delegates in October 2001. The 2001 Future of Dentistry report is intended to be a practical guide for the profession's next generation. It is meant to stimulate thoughts and actions that will move the dental profession forward into the new century. Within the report are one hundred and fourteen recommendations that suggest possible approaches to issues that will be important to the future of the oral health of the American public and the dental profession.

The vision statement of the report is simple but paramount: Improved health and quality of life for all through optimal oral health.

The completed report describes current trends and future issues for six broad areas of the profession: (1) clinical dental practice and management, (2) financing of and access to dental services, (3) dental licensure and regulation of dental professionals, (4) dental education, (5) dental and craniofacial research, and (6) global oral health. Both the full report and an executive summary are available from the American Dental Association. This article uses excerpts from the full report to provide a condensed review of some of the report's important topics. Financing of dental services, access to dental care, and dental workforce are emphasized.

Clinical Dental Practice and Management
Clinical practice includes, but is not limited to, those oral health services provided by dentists in the dental office and those community-based programs such as community water fluoridation, oral cancer screening, and sealant programs. Clinical care is influenced by the demographics of the population, patterns of dental disease, and the expectations of both patients and providers. Demographically, the United States population is growing older and more ethnically and culturally diverse.

Advances in technology are quickly transforming the dental workplace.

Dr. Seldin is in private practice in New York City and was chair of the Oversight Committee for the Future of Dentistry Project.

Dr. Brown is Associate Executive Director, American Dental Association, 211 East Chicago Avenue, Chicago, Illinois 60611-2678.
### Table 1. Percentage of Patients Receiving Selected Dental Services From Private Practitioners in the United States, by Year.

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<thead>
<tr>
<th>Procedure</th>
<th>1959</th>
<th>1969</th>
<th>1979</th>
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<td>Oral Examination</td>
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<tr>
<td>Fluoride Treatment</td>
<td>0.9</td>
<td>4.0</td>
<td>6.8</td>
<td>9.8</td>
<td>10.6</td>
</tr>
<tr>
<td>Amalgam, 1 Surface</td>
<td>20.1</td>
<td>15.9</td>
<td>8.5</td>
<td>5.3</td>
<td>3.0</td>
</tr>
<tr>
<td>Amalgam, 2 Surfaces</td>
<td>20.6</td>
<td>16.4</td>
<td>9.6</td>
<td>7.2</td>
<td>4.0</td>
</tr>
<tr>
<td>Crown</td>
<td>1.6</td>
<td>2.9</td>
<td>5.2</td>
<td>5.3</td>
<td>5.9</td>
</tr>
<tr>
<td>Root Canal</td>
<td>1.9</td>
<td>2.9</td>
<td>3.2</td>
<td>2.6</td>
<td>3.3</td>
</tr>
<tr>
<td>Extraction</td>
<td>13.0</td>
<td>9.8</td>
<td>5.4</td>
<td>4.9</td>
<td>3.7</td>
</tr>
<tr>
<td>Resin - Anterior</td>
<td>4.4</td>
<td>4.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resin - Posterior</td>
<td>1.9</td>
<td>4.8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: These are unpublished data are subject to revision upon further analysis.

New information management technologies and advanced diagnostic and treatment tools are improving diagnosis, patient care, and patient care management. A major challenge for dental practice managers will be to achieve a coordinated, systematic, and secure approach to the integration and application of information technology.

The dental profession's success in reducing caries, periodontitis, and tooth loss has dramatically improved the oral health status of the United States population. Given the improvement in the oral health of children and adults, and increasing knowledge of oral disease patterns and treatment options, it can be expected that future clinical practice will incorporate more diagnostic-based data into treatment plans along with prognosis for dental treatment. A key pathway toward achieving this objective is the development of suitable facilities and personnel.

Many factors will affect the required number of dentists. Aging and demographic changes in the dentist workforce need to be carefully evaluated on a continuing basis. Dentists' productivity should be monitored. The availability of allied dental personnel is critical. Demand for dental services also plays an important role in workforce requirements. Given an uncertain future, flexibility is a desirable strategy for workforce policy. Regional issues do exist and may become more pronounced in the future.

Strategies to assure available facilities and personnel should begin with a comprehensive and ongoing assessment of the dental profession workforce. Current dental workforce models should be continually evaluated, updated, and refined so that the most accurate predictions possible are available for the number, type, and distribution requirements of dental personnel.

### The Future of Clinical Practice.

The nature of dental office operation, both managerial and clinical, will continue to be affected by the rapid advancement in technology. While many offices are now comfortable with the use of computer technology for administrative functions and some simpler diagnostic services, the explosion of new approaches to dental care that are based in emerging technology will require greater sophistication on the part of the practitioner.

![Figure 1: Nominal & Real Dental Expenditures 1960-1998 (1998=100).](source: Health Care Financing Administration and U.S. Department of Labor, Consumer Price Index, Bureau of Labor Statistics.)
Data collection and documentation will become a valuable new tool for the dental practice, and the communication of data will evolve so that all patient information will be instantly accessible and transferable between dental offices and other health care professionals.

As a result, a major challenge for dental practice managers will be to achieve a coordinated, systematic, and secure approach to the integration and application of information technology. Many of the issues in sharing data and setting up such systems are not solely technical in nature, but rather involve legal, economic, and political considerations (Schleyer, 1999; Willis et al, 1997).

Trends in the development of new diagnostic tools and therapeutics, combined with an aging population, may require dental professionals to incorporate more medical treatment into dental practice, in addition to the traditional dental-surgical approach.

Computers will serve as decision-support tools in planning treatments that require the integration of multiple disciplines and types of clinical information. Software programs will help dentists filter, evaluate, and prioritize information essential for establishing suitable treatment plans. As more patient data are stored on computers, a variety of outcomes analyses of patient records will become possible at three levels: patient, practice, and population. Computers will aid dentists in the assessment of a patient's health status over time.

Diagnostic codes will provide a basis for assessing treatment efficacy when measured against established parameters and will assist in assessing outcomes data for patients and dental practices. It will be possible to collate local and regional data into larger dental epidemiological databases—important tools for assessing treatment efficacy.

In summary, the dentist of the future will have to be far more computer-literate than today's practitioners. The use of new technology will allow a higher level of care with greater efficiency and productivity. The dental schools and institutions providing life-long learning to practitioners will need to increase the amount of technology information provided. While the patient population will benefit from these advances, it will be a challenge for the profession to incorporate the advances into everyday dental practice.

**Financing of Dental Services**

Since most dental care in the United States is provided through private markets, an assessment of the demand for dental services is important for understanding the amount of dental services that will be provided, who will have access to those services, and the adequacy of the dental workforce to provide those services (Brown, 1989; Brown & Lazar, 1998; Tuominen, 1994). The demand for dental services is significantly responsive to changes in dental fees—the higher the fees, the lower the demand. Other factors that influence the level of demand include income, family size, population size, education levels, prepayment coverage, health history, ethnicity, and age.

Most factors that positively influence demand for dental care have been expanding. The United States economy has grown robustly for most of the past two decades, resulting in an increase in discretionary income among Americans (Beazoglou, Brown et al, 1993; Brown, Beazoglou et al, 1994). People are becoming more knowledgeable about dental health and what is required to maintain it. As the population has become more affluent and educated, the value placed on oral health has increased. In addition, the desire for esthetic dentistry has grown and will probably continue to do so. All of these factors have enhanced the demand for dental services.

Disease levels and trends also are important to obtain a complete view of the conditions influencing the demand for care. Dental caries has been the primary foundation of the demand for dental services in modern times, and dental caries has been declining in almost all segments of the child population and, to a lesser degree, in adults up to about the age of forty-five years (Brown, 1989; Brown, Wall & Lazar, 2000; Brown, Wall & Lazar, 2002). With this decline, comes a decline in the need for dental services to treat caries. The population forty-five years of age and older experienced caries in substantial amounts during their younger years and will require continued management of the consequences of the original caries.
Due to changing disease patterns, the dental sector is going through a transition from a service mix that has been predominately therapeutic to a service mix that will be mostly preventive. As shown in Table 1, prophylaxes and examinations more than doubled between 1959 and 1999, while amalgam restorations declined by 75% (American Dental Association, 1994 and 2001a). The decline in amalgams is only partly compensated by an increase during the 1990s in the number of posterior resins and other cosmetic materials provided.

A study by Eklund and colleagues also reports service mix changes (Eklund, Pittman et al, 1997). In an insured population, there were marked declines between 1980 and 1995 in restorations, crowns, dentures, and extractions. Endodontic procedures declined in younger patients but were stable or increasing in older patients. Over the same time period, there were increases in diagnostic, preventive, and periodontal services. Changes of this magnitude will have profound effects by reducing the demand for some services and enhancing the demand for others. The total effect of changes in disease patterns is likely to diminish overall demand but other factors, such as a growing economy, are likely to increase demand. The timing and impact of these factors—in combination—on the demand for dental services are not well understood.

### Table 2. Census Counts and Projections of United States Resident Population, Professionally Active Dentists, Active Private Practitioners, Professionally Active Dentists and Active Private Practitioners per 100,000 United States Resident Population, 1976-2020.

<table>
<thead>
<tr>
<th>Year</th>
<th>United States Resident Population (in thousands)</th>
<th>Professionally Active Dentists</th>
<th>Active Private Practitioners</th>
<th>Active Dentists Per 100,000 Residents</th>
<th>Active Private Practitioners Per 100,000 Residents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1976</td>
<td>217,563</td>
<td>110,276</td>
<td>100,051</td>
<td>50.7</td>
<td>46.0</td>
</tr>
<tr>
<td>1978</td>
<td>222,095</td>
<td>117,044</td>
<td>106,672</td>
<td>52.7</td>
<td>48.0</td>
</tr>
<tr>
<td>1982</td>
<td>231,664</td>
<td>126,985</td>
<td>116,208</td>
<td>54.8</td>
<td>50.2</td>
</tr>
<tr>
<td>1987</td>
<td>242,289</td>
<td>137,817</td>
<td>126,357</td>
<td>56.9</td>
<td>52.2</td>
</tr>
<tr>
<td>1991</td>
<td>251,802</td>
<td>150,762</td>
<td>138,094</td>
<td>59.9</td>
<td>54.8</td>
</tr>
<tr>
<td>1992</td>
<td>254,933</td>
<td>152,925</td>
<td>140,349</td>
<td>60.0</td>
<td>55.1</td>
</tr>
<tr>
<td>1993</td>
<td>258,103</td>
<td>155,087</td>
<td>142,603</td>
<td>60.1</td>
<td>55.3</td>
</tr>
<tr>
<td>1994</td>
<td>261,312</td>
<td>157,228</td>
<td>144,247</td>
<td>60.2</td>
<td>55.2</td>
</tr>
<tr>
<td>1995</td>
<td>264,561</td>
<td>158,641</td>
<td>146,089</td>
<td>60.0</td>
<td>55.2</td>
</tr>
<tr>
<td>1996</td>
<td>267,850</td>
<td>160,388</td>
<td>147,778</td>
<td>59.9</td>
<td>55.2</td>
</tr>
<tr>
<td>1997</td>
<td>271,180</td>
<td>160,781</td>
<td>151,309</td>
<td>59.3</td>
<td>55.8</td>
</tr>
<tr>
<td>1998</td>
<td>274,552</td>
<td>163,291</td>
<td>151,309</td>
<td>59.5</td>
<td>55.1</td>
</tr>
<tr>
<td>1999</td>
<td>277,966</td>
<td>164,664</td>
<td>152,151</td>
<td>59.2</td>
<td>54.7</td>
</tr>
<tr>
<td>2000</td>
<td>281,422</td>
<td>166,049*</td>
<td>153,431*</td>
<td>59.0</td>
<td>54.5</td>
</tr>
<tr>
<td>2005</td>
<td>294,108</td>
<td>170,476*</td>
<td>160,318*</td>
<td>58.0</td>
<td>54.5</td>
</tr>
<tr>
<td>2010</td>
<td>306,524</td>
<td>173,942*</td>
<td>163,328*</td>
<td>56.7</td>
<td>53.3</td>
</tr>
<tr>
<td>2015</td>
<td>319,205</td>
<td>177,076*</td>
<td>166,088*</td>
<td>55.5</td>
<td>52.0</td>
</tr>
<tr>
<td>2020</td>
<td>332,145</td>
<td>179,930*</td>
<td>168,528*</td>
<td>54.2</td>
<td>50.7</td>
</tr>
</tbody>
</table>

rate of increase in the United States population, which was 1.1%. Thus, total expenditures have been driven primarily by population growth.

The percent of the population who visited a dentist within the previous year increased substantially during the last four decades from about 35% in the late 1950s to about 64% in 1998 (Jack, 1986; Kovar, Jack et al, 1988; Bloom, Gift et al, 1992; Brown & Lazar, 1999; National Center for Health Statistics, 1988). However, real expenditures among persons who visited a dentist have declined. The triangles in Figure 2, demonstrate the decline in real per user expenditures since 1982. Dental expenditure data collected with nationally representative surveys (Edwards & Berlin, 1989; Cohen, 1997) confirm the decline, showing a decrease in real expenditures per user from $541.99 in 1987 to $475.52 in 1996.

Eklund found that the large shift in mix of dental services from 1980 to 1995 did have an impact on dental expenditures (Eklund, Pittman et al, 1998). For example, restorative procedures per user declined from 1980 to 1995 (Eklund, Pittman et al, 1997); so did expenditures per user for those procedures (Eklund, Pittman et al, 1998). Preventive and diagnostic services increased per user, as did expenditures for those services.

Innovation in Dental Financing Arrangements. Patients are experiencing greater limitations, restrictions, exclusions, larger co-payments, static maximums, and administrative problems which are contributing to their growing frustration. If these factors continue and are not corrected, they will lead to growing dissatisfaction on the part of patients; some may be unwilling to continue their dental insurance plans.

Changes in technology, disease patterns and demographics may stimulate development of new dental benefit programs that would have different reimbursement methods, incentives, and covered benefits. These changes could impact the types of services provided. Innovative dental insurance programs should be developed to respond to these changes.

Dentistry must commence constructive dialogue with third-party carriers designed to develop a user-friendly attitude and more efficient administrative procedures in their dealings with providers and purchasers. It is important that the dental profession encourage the dental benefits industry to streamline their procedure, reduce administrative burden and policy limitations, and provide greater flexibility for covered individuals in their reimbursement for dental services.

The Future of Financing Dental Services. What will happen with dental expenditures in the future is far from certain. The U.S. population will continue to grow but it also will age and become more diverse. If the percentage of the population who visits a dentist does not continue to increase at a similar rate or if expenditures per user continue to decrease, then a decline in real per capita expenditures for the overall population could occur. If that happens, growth in total demand would depend on the population growing at a faster rate than the decline in per capita expenditures. However, many factors could intervene. Economic growth, as well as an increasingly educated population, are likely to provide a stimulus to dental demand. New availability of treatment modalities and a documentation of a causal link between oral disease and some systemic diseases are less certain, and their impact on demand is more unsettled. Dental procedures to alter the appearance of individuals may grow in importance. Technical and scientific advances will occur but their timing and effect on demand are unpredictable. As birth cohorts with different disease patterns work their way through the age distribution, case mix will shift and have a substantial impact on potential demand. Younger cohorts with less disease...
Future of Dentistry

Table 3. Percentage Distribution of Part-time Active Private Practitioners, by Gender and Age Group.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>1987</th>
<th>1994</th>
<th>1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987</td>
<td>10.2%</td>
<td>13.6%</td>
<td>14.7%</td>
</tr>
<tr>
<td>1994</td>
<td>4.6%</td>
<td>4.9%</td>
<td>5.6%</td>
</tr>
<tr>
<td>1999</td>
<td>8.1%</td>
<td>8.7%</td>
<td>8.7%</td>
</tr>
<tr>
<td>60 years of age or older</td>
<td>40.5%</td>
<td>42.1%</td>
<td>46.2%</td>
</tr>
</tbody>
</table>

* Data are unreliable because the number of respondents was too low.


will probably require less restorative and rehabilitative services as they grow older.

Access to Dental Services

In order to assure that the American public will have access to dental care without artificial barriers—established by virtue of a lack of coordination between the dental profession and the financing institutions—organizational partnerships must be established. By joining together with the best interests of the public at heart, the problems that encumber patients, dentists, and insurance companies can be solved. With the full cooperation and enthusiastic efforts of these parties, dental care will become more easily accessible for a larger segment of the American public.

However, there remains a significant portion of the American people who are unable to access care for other reasons. The guiding vision for the dental profession is that all Americans will be able to receive the dental care they need, regardless of their financial, geographic, or health status, or other special circumstances. The dental profession is eager and willing to assist in securing access for all Americans. However, providing access to dental care for all requires broad-based cooperative efforts. Most dentists provide free or discounted care to people who otherwise could not afford it (Manski, Moeller et al., 1999; American Dental Association, 1998). But charity alone is not enough. We as a society—policymakers, the dental profession, community leaders, and the public—must summon the political will to break down financial and other barriers that diminish access to care.

The large majority of Americans can and do access dental services, and the private delivery system provides high-quality dental care for those who avail themselves of it. However, for the numerous individuals who face barriers to care, commitment must be made to develop new and innovative approaches to facilitate access.

We as a society—policymakers, the dental profession, community leaders, and the public—must summon the political will to break down financial and other barriers that diminish access to care.

The Economically Disadvantaged. There are two large groups of people with low incomes. One group consists of those with incomes below the federal poverty level, and their family members. In 1996, this group consisted of thirty-eight million people, or 14% of the U.S. population. Many in this group are the long-term unemployed. The second group consists of the working poor: those who fall between 100% and 200% of the federal poverty level, and their family members. In 1996, this group consisted of fifty-three million people, or 20% of the population. Within both of these groups are found a disproportionate number of African Americans, Hispanics, Native Americans, and recent immigrants.

To address the needs of the long-term unemployed, public funding should be expanded such that it would cover basic dental services. In order to assure participation by providers and improve access, dentists should be reimbursed at market rates for their services. For the working poor, new programs, subsidized in part by public funding, should be developed in which employees could purchase insurance plans directly from risk pools if their providers do not provide it.

The Disadvantaged in Geographically Isolated Areas. Adequate availability of dental care is a problem for the poor in inner cities and rural areas. Financing care for the long-term unemployed and the working poor are essential first steps to address access. Additional efforts are needed to increase availability to care for those groups in geographically isolated areas. The dental profession should encourage dentists to provide services in these locales. In order to accomplish this, incentives must be offered to attract dentists to underserved areas. These could include loan forgiveness, tax credits, or adequate reimbursement rates for government-funded dental plans.

Special Populations and Individuals with Disabilities. Access for special populations and individuals with disabilities is difficult because of the special needs of these individuals and the complex management of their care. Many of
these patients are homebound, institutionalized, or unable to cooperate with care in a traditional dental setting. Furthermore, health providers require special skills and educational background to effectively manage some of these individuals’ health problems. Financing for the care of this group of people will require reimbursement rates at levels that will attract providers to undertake the additional training necessary to manage these patients. In addition, educational programs to train providers with the necessary specialized skills should be developed and widely implemented.

The solution to these problems should include the development of publicly funded or subsidized programs that would serve people with disabilities, recognizing their special needs. Outreach programs at the state and local levels should be developed which would meet the needs of patients unable to receive care in traditional dental offices.

The Elderly. Utilization and access among the elderly have increased, resulting in much improved oral health. This trend is likely to continue. Although many of the elderly can budget for dental care without dental prepayment, others might access care to a greater degree if prepayment were available. There is evidence that employers are reducing retirement-based prepayment coverage for their former employees. The development of a market-oriented solution to this lack of coverage, supplemented by the growing economic resources and improved oral health of the elderly, will meet many of the access needs of this population.

The establishment of tax-deferred dental and medical savings accounts in which the proceeds could be used by the elderly during their retirement would be a large step in solving this developing problem.

The Future of Access to Dental Services. The dental profession’s vision for access to dental care is that all Americans will have the ability to receive the highest quality dental care. For most Americans the current dental services delivery system works very well. More than three out of four people from non-poor families report at least one dental visit in the previous year. For these people access is excellent and will continue to be in the future. Even among the disadvantaged, access to care and oral health has improved significantly in the last thirty years. Nevertheless, many financially disadvantaged people and people who live in geographically isolated areas continue to have inadequate access to care.

A primary determinant of access to dental care is having the financial resources to purchase services. The availability of resources is highly dependent on the overall growth of the economy. Gains in purchasing power have affected all segments of the population, but the poor and the near-poor have less purchasing power than the wealthier segments of society.

The most effective way to give the poor greater purchasing power is to subsidize their access to care using public funds. Without adequate public funding, the efforts by the dental profession and others to provide the poor adequate access to dental care will continue to fall short.

The Dental Workforce
The number of dental school graduates declined from a high of 5,756 in 1982 to a low of 3,778 in 1993, a decrease of 34%. Since 1993, graduates increased steadily to 4,041 in 1999 (American Dental Association, 2001b). The decline in number of graduates during the 1980s slowed the rate of growth of practitioners. As shown in Table 2, the number of professionally active dentists and private practitioners increased during the 1990s. However, their growth rates were slightly less than the growth in the United States population. As a result, dentist-to-population ratios started declining around 1995 and have continued to decrease (American Dental Association, 2001b). Overall, there has been a 0.91% decline in the ratios.

Women Dentists. Since the mid-1970s, women have entered dental schools and, subsequently, dental practice in increasing numbers. According to the ADA census of dentists, Distribution of Dentists, the total number of active private practitioners in the United States in-
increased from 116,208 in 1982 to 152,151 in 1999, a 30.9% increase. The number of female active private practitioners increased from 3,029 to 21,960 during this same period, an increase of 625%. Figure 3 shows the percent distribution of active private practitioners in the United States by gender. In the early 1970s, there were very few women dentists. By 1982, female dentists comprised 2.7% of the dentist workforce; by 1999 they comprised 14.4%.

The increase in the number of female dentists resulted from an increase in female dental school graduates during the same period. Between 1982 and 1999, female dental graduates increased 72.6% (from 838 to 1,446) while the overall number of graduates decreased by 23.8% (from 5,371 to 4,041). The percent distribution of graduates by gender is depicted in Figure 4. By 1982, women comprised 15.6% of total dental graduates; their percentage increased to 39.2% in 1994. Since then, the percent distribution of female graduates leveled off, fluctuating from year-to-year in the high thirty percent range (American Dental Association, Surveys of Predoctoral Dental Education, various years).

The ADA's Dental Workforce Model forecasts that 29.2% of active private practitioners will be female by 2020 (American Dental Association, 2001b). See Figure 3.

**Part-Time Practice.** Among male private practitioners, the percentage who worked part-time (defined here as spending less than thirty hours per week in the office) increased from 10.2% in 1987 to 14.7% in 1999. As shown in Table 3, among female private practitioners, the increase was from 26.3% to 29.9% (American Dental Association, 1989, 2001c). Higher part-time distribution among females younger than forty years of age is likely related to childbearing and child-rearing responsibilities. Also, within this age category, female dentists tend to be younger and, therefore, involved in the starting and establishing their practices.

As indicated in the section on dentists' productivity below, there is no significant difference between productivity of men and women dentists on an hourly basis. Also, full-time women dentists work as many hours as full-time male dentists. The same is true for part-time men and women dentists. Thus, the impact of women on workforce output can be roughly approximated by multiplying the percentage difference in men and women dentists who practice part-time (15%) by the percent of women in the dentist workforce. Currently, this calculation indicates about a 2% reduction in total dental output; and the same calculation for 2020, indicates that the impact of women on total output will be less than a 5% reduction.

**Table 4. Annual Growth Rates in the United States Population, Dental Output, and Output per Dentist, 1960-1998.**

<table>
<thead>
<tr>
<th>Year</th>
<th>U.S. Population</th>
<th>Dental Output</th>
<th>Output per Dentist</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960-98</td>
<td>1.02%</td>
<td>2.95</td>
<td>1.31</td>
</tr>
<tr>
<td>1960-74</td>
<td>1.18%</td>
<td>5.01</td>
<td>3.95</td>
</tr>
<tr>
<td>1974-91</td>
<td>0.96%</td>
<td>1.84</td>
<td>-0.13</td>
</tr>
<tr>
<td>1991-98</td>
<td>0.98%</td>
<td>1.80</td>
<td>1.05</td>
</tr>
</tbody>
</table>


**Dental Workforce Diversity.** By the year 2020 the United States population is expected to grow to 332,145,000. The rate of growth is expected to be 10% per decade from 1990 to 2020. During this period, it is anticipated that 55% of the growth in the United States population will be due to immigrants and their descendants. Growth will be greatest among Hispanics and African Americans (Murdock & Hogue, 1998).

Since 1990, however, there has been a 23% decline in dental school enrollment of Hispanics, African Americans, and Native American students (Valachovic, 2000). Asian/Pacific Islanders represented 24.5% of first-year enrollees in 1998. Consequently, at the very time the United States population is becoming increasingly diverse, the future supply of dentists is becoming less representative of the population it will serve.

**Productivity of Dentists.** There are generally two ways to increase dental system tripled between 1960 and 1998, growing at an annual rate of 2.95% (Beazoglou, Heffley et al, 2001). See Table 4. Change in dental output results from an increase in the number of dentists or from improved productivity per dentist. By accumulating the annual growth rates over the entire period, the total increase in dental output and output per dentist can be calculated. The contributions to the increase in dental output from increases in the number of dentists and in dentists' productivity (i.e., the amount of dental output, measured as real gross billings per hour) were almost equal: the number of dentists increased 1.85 times, and dentists' productivity increased 1.64 times.

Increasing the number of dentists' hours by producing more dentists may not be the most cost-effective way to increase productivity and, subsequently, dental services. Interestingly, once other factors are held constant, neither gender nor age is a significant factor in produc-
tivity. Female dentists are just as productive as male dentists. Also, older and younger dentists can produce at the same rate.

**Geographic Distribution of Practicing Dentists.** The distribution of dentists varies substantially by geographic area. Reports indicate specific geographical areas are either currently experiencing or predicting declines in the number of practicing dentists (Cooksey, 1999; Dohm, 1999; Smetanka, 2000). North Dakota anticipates losing 40% of its dentists to retirement in the next decade. South Dakota expects that 35% of its dentists will retire in the coming decade. Minnesota data indicate that dentist-to-population ratios, which improved through the 1980s, have reverted to 1973 levels in the last decade (Born, 2001). Other states indicate that they have sufficient numbers of practicing dentists, and some states have expressed concerns regarding an over-abundance of dentists.

There are rather pronounced geographic imbalances in the dental workforce (Brown & Petersen, 2001). One of the reasons for these geographic imbalances is the rapid shifts that are occurring in the United States population, which increased from 248.7 million to 281.4 million between 1990 and 2000—a 13.2% increase. The largest increases occurred in the western and southern states: Nevada, Arizona, Colorado, Utah, Idaho, Georgia, Florida, Texas, North Carolina, Washington, Oregon, and New Mexico all showed 20.0% or greater increases in their populations. Ohio, Rhode Island, Maine, Connecticut, Pennsylvania, West Virginia, and North Dakota showed smaller gains (less than 5.0%). Only the District of Columbia lost population, with a decrease of 5.7%.

Similar to the pattern of population growth, the largest increases in the number of active private practitioners were seen in the western and southern states: Nevada, Utah, Washington, Wyoming, Idaho, Florida, Arizona, North Carolina, South Carolina, Colorado, and Delaware all showed greater than 11.0% increases in the number of active private practitioners. Connecticut, Iowa, Wisconsin, Michigan, and West Virginia showed less than 1% increases in the number of active private practitioners. Minnesota, the District of Columbia, and Missouri lost dentists between 1993 and 1999.

Near one-half of the states showed an increase in the dentist-to-population ratios. Most of these states have not expressed significant concerns regarding the adequacy of the size of their dental workforce. Some have expressed concerns that they may be entering a period of over-abundance of dentists.

Dentist-to-population ratios are crude measures of the adequacy of the dentist workforce and should be used with caution. This caution clearly applies to regional workforce assessments. When the dentist-to-population ratios are adjusted for productivity increases, the productivity-adjusted ratios show an increase in the productive capacity per 100,000 population for most states between 1993 and 1999.

**Allied Dental Personnel.** The dentist’s ability to expand the service capacity of his or her practice lies, in part, in the ability to delegate tasks to dental assistants and dental hygienists. Research from the 1970s has demonstrated that many functions could be delegated safely, effectively, and with quality comparable to those provided by dentists (Mullins et al, 1979; and Mullins et al, 1983).

Unfortunately, it is evident that there exists a shortfall in the numbers of qualified allied personnel for dental offices. Dentists in many areas of the country are finding it very difficult to obtain the support necessary to operate their facilities so as to satisfy the demand from their patients. The supply of dental laboratory technicians is also severely inadequate. It is important to assure that there are sufficient numbers of allied personnel and that they are able to work in areas of the country where their services are required.

The increasing demand for preventive dental services requires greater use of personnel from the allied dental team. There are regional shortages of dental hygienists that increase the difficulty of fulfilling staffing needs. The lack of mobility of dental hygienists created by state licensure processes is another factor contributing to the staffing shortfall for dental hygienists. Varying levels of duties allowable in states cause discrepancies in training, ability and compensation. This, in turn, inhibits geographic mobility.

To encourage potential applicants to enter the profession, and to retain qualified hygienists, authorized duties should be commensurate in all venues and the ability to move from one state to another should be possible. In addition, the duties allowed for dental assistants should be uniform among all states, allowing well-trained and experienced individuals to provide services in areas to which they move.

Thus recommendations have been made to address the regional workforce discrepancies as well as the need to increase the supply of allied personnel.

**The Future of the Dental Workforce.** Currently, the national dentist workforce seems to be adequate. However, circumstances can change. The nation and the dental profession must follow the national workforce trends carefully and be ready to act when circumstances warrant action.

Regional workforce issues do exist and may become more pronounced in the future. However, given these widely varying workforce conditions among the states, it is apparent that one overall national policy will not fit the specific needs of various states. States with a sufficient number of practitioners will require a different policy than those states in which the number of dentists is declining. Those latter states face potentially serious workforce issues that should be addressed with their state-specific needs and circumstances in mind.

To assure that dental services are available to all who need them, it is imperative to establish the adequacy of the dental workforce. The workforce differs across the country and within specific communities. Factors that must be considered when evaluating the adequacy of the workforce in any geographic area include the socioeconomic status, race and ethnicity, disability or
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handicapped status, and disease patterns of the population. Other factors that impact the capacity of the dental workforce are productivity, efficiency, extent of duties of allied personnel, new technology and techniques, and emerging research that alters the manner of diagnosis and treatment.

The national supply of dental services will increase substantially due to enhanced dental productivity. There is potential to increase dental output through more efficient use of allied dental personnel. These factors indicate that an increase in the aggregate number of dentists may not be necessary. Nevertheless, the nation must be ready to act if circumstances change.

Existing regional workforce imbalances may become more pronounced in the future. Given the widely varying workforce conditions among states, one overall national policy is not likely to satisfy every state's needs. Each state should address its workforce issues based on its specific circumstances.

Flexibility is a desirable strategy for workforce policy. If more dental capacity is needed, an attractive workforce option is to adjust the number of allied dental personnel. This is a cost-effective means to generate additional dental services. However, dental hygienists and dental assistants are not available in sufficient numbers in some regions of the country. Open positions for dental hygienists in dental offices are difficult to fill, sometimes remaining vacant for extended periods of time.

Continued study of dental workforce adequacy is essential. Studies should assess the number of dental care providers available to treat the public and should provide an in-depth analysis of the need for dental care as well as the demand for dental care. Studies should address the capabilities and duties of the various members of the dental team and establish whether alterations must be made to assure that the public can be adequately served.

Licensure and Regulation of Dental Professionals

Dentistry is a highly respected profession for many reasons. As individuals, dentists provide a valued service in their communities, enjoy strong relationships with their patients and are much regarded for their integrity, compassion, and skills. Dentistry is the same for all regions of the U.S. and should be applied universally for all patients. In addition, regional differences in examinations make it difficult for individuals to prepare for the various requirements. Also, for individuals taking the examination at a location where they do not reside or where they did not train, it is especially difficult to find patients exhibiting the appropriate case-mix required by the examination administered at that location. In order to prepare their students for initial examinations, regional differences in examination content variation require dental schools to vary their curricula in ways not indicated by dental science. Thus the Future of Dentistry report recommended that the dental profession establish as a goal the equivalence or unity of all examining bodies.

Specialty Licensure. The knowledge and clinical skills between general dentists and ADA-recognized specialists are substantially different. As dental specialists continue their education and practice, their clinical skills become further removed from their original training as general dentists. In many areas, additional examinations are required for a specialty license. The requirement that a previously licensed specialist be re-examined as a general dentist when relocating is an unnecessary burden that does not protect the public or improve patient care. Such a requirement compels specialists to practice outside the scope of their specialty in order to retrain themselves for a general dentistry examination.

The dental profession should encourage all licensing boards to develop guidelines and procedures that allow for the examination of educationally-qualified specialists in their respective areas of expertise without requiring concurrent examination for a general dentistry license.

Licensure by Credentials. The dental profession has supported the freedom of movement of dentists within the U.S. This is an important principle of personal and professional freedom. More importantly, without such potential mobility, addressing regional and local workforce imbalances are
more difficult. While the dental profession has supported the concept of licensure by credentials in all states, progress has been slow in the past few years. It is important that efforts to achieve licensure by credentials in all states be intensified.

Regulation. In recent years, regulatory activity has had a profound effect on the manner in which dentistry is practiced. Whereas some of this regulatory activity has been appropriate and welcome, much of it has been justly criticized as being insufficiently substantiated by scientific data. Any regulations pertaining to dental practice must be based on valid scientific principles. Regulations will only be beneficial if they add safety and value to the services provided and if compliance does not require unreasonable burden. The dental profession must remain a leader in developing and influencing legislative and regulatory activity affecting dentistry.

Dentistry, and all of its partners, must continue to be vigilant and proactive in identifying and researching potential hazards that might impact the safety of patients, the dental workforce, and the environment. Public attitudes and opinions, shaped by the proliferation of ideas and assumptions, both correct and incorrect, must not be allowed to lead to legislative initiatives or regulations without scientific validation. All affected parties must work together to ensure that valid science is the basis for necessary and appropriate regulation.

The Future of Licensure and Regulation. It is very important that the dental profession continue to maintain the competency of dentists and allied dental personnel through innovative approaches to education, strengthened standards for continuing education credits, and outcome assessments for relicensure and recertification. Finally, regulation must be based on valid scientific evaluation and guard against over-regulation caused by special interest, single-focus groups. Dentistry must foster scientific examination, evaluation, and prevention in the area of regulation as it has in oral health. If successful, the profession will be able to continue its service to the public unimpeded by unnecessary regulation.

Dental Education

The generation of new knowledge through research and scholarship, and the transmission of that knowledge through teaching, learning, and practice are at the heart of dental education's commitment to quality patient care and professional renewal.

The relationship between the quality of dental education and the training of dental professionals is clear—all dentists are the product of dental education. The contemporary dental school provides the dental profession with two critically important benefits. First, the nation's dental schools are the practicing profession's sole link to the university and, with it, the esteem and professional status that dentistry enjoys. Second, dental schools continually generate and expand the science and technology base that permits dental professionals to maintain the public's trust, and to practice in a progressively more advanced and effective fashion.

United States dental schools have achieved immense success and unparalleled accomplishments. However, many schools are financially over-extended, operate in antiquated physical facilities, and face a serious faculty shortage. While the opportunities for future dental professional education are bright, the dental education system's ability to help its students realize those opportunities may be in some doubt.

Faculty Development. The growing number of faculty vacancies, espe-
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In the long run, neither dentistry nor dental education will flourish if dentistry seeks to go it alone at every opportunity.

new knowledge and techniques, diminished quality of teaching and care, and greater dependence on dental graduates from non-accredited schools.

It is not possible for the educational institutions to meet the challenge alone. The expertise and experience available in the practicing community is invaluable to achieve the continued development of a high-quality dental workforce. The reward of participating in the educational process is great and practitioners should be encouraged to seek out opportunities to help their dental schools.

In order to provide the schools with individuals competent to operate comfortably and effectively in the educational environment, training programs should be developed to provide prospective faculty members with the necessary skills. Using distance learning combined with structured hands-on training, a significant number of practitioners could be trained as faculty clinicians within a short period of time.

Faculty Workforce. Efforts must be made to encourage individuals to enter into the education and research communities. The efforts to attract people to enter these career tracks are encumbered by financial inadequacies within these fields of endeavor. Graduating dentists, who are saddled with enormous debt and cognizant of the limited income potential available in education and research, shy away from these avenues in favor of the potentially more lucrative private practice arena.

As shown in Table 5, the number of vacant faculty positions has been increasing during the 1990s (Bertolami, Beemsterboer et al, 1999). This trend can only be countered by the development of special educational tracks that could be entered during predoctoral education and coupled with the offer of financial incentives such as debt forgive-

Dental and Craniofacial Research

Research is the process by which new information is obtained and existing tenets are modified. Research involves experimentation and observation, and through this mechanism, information is converted to practical application.

Through epidemiological and behavioral research, the dental profession has made advances in understanding the causes and progression of dental disease. The ultimate objective of research is to improve oral health, eliminate health disparities, and enhance quality of life. Dental research has led to developments in disease prevention, diagnosis, and treatment modalities. During the past century, there has been a shift from an approach based on treatment of disease to prevention of disease. The caries-preventive modalities of fluoride and of dental sealants have had a major impact on the dental health of Americans.
Financial Support for Dental Research. Funding for dental research comes from both public and private sources. The primary public agency that supports behavioral and biomedical research is the National Institute of Dental and Craniofacial Research (NIDCR). Dental research support also is provided by other agencies in the Department of Health and Human Services.

Most publicly funded dental research in the United States is conducted in dental institutions by investigators who come from a wide variety of disciplines. United States investigators located in dental schools also have established collaborations with investigators throughout the world. Industry (i.e., dental product manufacturers, pharmaceutical companies, biotechnology firms, and foundations) also provides funding for dental research and development. Much of this support is also for research conducted in dental institutions.

Nevertheless, funding for dental research lags behind that for other diseases and conditions. Greater investments in research are required for dentistry to expand its capacity to promote health, to diagnose and manage individual and community risk factors, and to enhance functional rehabilitation.

Research Workforce. To ensure the nation's research capacity, a concerted effort is needed to develop and build the dental research workforce. There is a paucity of new investigators entering careers in dental research. The reasons for this situation are complex.

Despite the NIDCR's support, there has been a critical decrease in the number of researchers. Barriers to entering a career in research include a lack of candidates with an expressed interest in research, a relative lack of workforce diversity, student debt, and misconceptions about the rewards of a career in research. Lack of a diverse pool of mentors also discourages the consideration of research as a career.

Most important to the future of dentistry is the need to promote the clinician scientist who will be able to work in an interdisciplinary environment, to transfer basic findings to the clinical setting (translational research), to design clinical trials, and to undertake health promotion research. All such dental clinician scientists should receive formal training to become a member of a clinical research team.

The Future of Dental Research. While the prevalence of dental caries and periodontal diseases may be changing for the entire population, these disorders are still common among segments of the population, especially those who are economically disadvantaged and particularly racial and ethnic minorities. Within the next decade, the dental profession and the United States health care delivery system should make primary dental treatment available to these underserved populations.

If a causal relationship can be established between dental infections and severe, life-threatening medical conditions, primary physicians may become active in diagnosing oral diseases and in referring their patients for dental care. Thus, dental and medical professionals should take a team approach to the prevention and management of dental diseases to limit their impact on overall patient health.

Within the next ten to twenty years, research will lead to new biological therapies for use by dental practitioners. Additionally, advances in molecular diagnostic and imaging technology will likely enhance and facilitate the detection and monitoring of dental diseases. Thus, the dentist of the future will require a degree of facility with, and an understanding of, fundamental biology in order to provide optimum patient care as novel treatments become available for dental caries, periodontal diseases, and other oral disorders.

Global Oral Health

"Global health" refers to health status, issues, and concerns that transcend geographic and political boundaries. The study of global oral health patterns reveals trends, profiles, and lessons for preventing disease and promoting health for our own population. Within the United States, the distinction between domestic and international health is losing its validity and may even be misleading in light of the rapid rate at which the United States population is becoming ethnically and racially diverse. Protecting the public health in the United States is a national responsibility for health professionals that might be well served by addressing global determinants of health and disease.

By engaging in collaborative actions that cross borders, the American Dental Association can understand the factors associated with global health and develop innovative strategies to improve oral health in the United States. Failure to engage in global activities, which enable the United States to prevent disease and ameliorate health, could jeopardize the nation's health and ultimately impact the economy (Institute of Medicine, 1997).

The important lesson learned from international comparative studies is that causes and solutions to specific health issues might evolve from multiple factors and that relying on only one set of factors may obscure more cost-effective and beneficial outcomes possible from alternative approaches.

Globalization and Partnerships. As globalization advances rapidly in this new century, crosscutting issues emerge that demand a collaborative approach to solving health problems. At the top of priority concerns is the global burden of infectious diseases and their effect on economic development within and across countries. A prime example is HIV/AIDS, but other infectious diseases having oral manifestations and other systemic diseases or conditions associated with oral pathogens are also of concern.

In addition, other genetically and environmentally triggered oral diseases and disorders—such as craniofacial birth defects, dental caries, and head and neck cancers—are candidates for a collaborative approach.

Globalization of Dental Education. Globalization of education is the inevitable result of several factors present during only the past several decades:

• The expansion of international travel during the past fifty years has greatly increased dental professionals' appreciation of the need for international cooperation and, even more...
importantly, of the value of international experience in improving the quality of education in their home institutions;

- The professional and scientific literature has become much more international—most major publications encourage contributions from all over the world;
- The mass media, especially television, have brought vital information on health status, quality of life, and socioeconomic factors from around the world directly into living rooms, making other countries and cultures seem familiar; and,
- The introduction of the Internet has made information available instantaneously throughout the world.

Globalization of Dental and Craniofacial Research. Solutions to many global oral health issues will rely increasingly on scientific and technological knowledge developed through research. Opportunities to expand knowledge depend in large measure on the availability of appropriately qualified scientific talent to address needed research questions and the availability of research cases. Both conditions lend themselves to more international involvement. The United States oral science workforce is among the best in the world, but has shortfalls in a number of critical areas, particularly in

While the United States government has neither the budget nor the mandate to support all needed international collaborative research, the United States dental profession does have the opportunity to advocate for such research and training, providing critical leadership through its existing strength in science and technology.

Changes in Oral Health Care Delivery. Countries—including the United States, with large population segments that have unique health care needs, such as the elderly, uninsured adults, young children, and recent immigrants—may find solutions to oral health problems by studying models and policies in societies that have comparable trends. The challenge is to understand the significance of these demographic and disease trends and to develop strategies to meet these needs. As the population ages, the systems by which health care is delivered, the sites for service delivery, and the mechanisms of payment may require options already found in countries with large populations of the elderly. Large segments of the world’s population live in developing countries that have few professionally trained health providers of any kind and little access to oral health care. These populations, in particular, need the industrialized world to provide them affordable prevention products and to help them develop treatment services that can be delivered by health workers already in the communities in need.

The vision for dentistry throughout the world is that the dental profession internationally will increase its commitment to and involvement in global oral health practice and promotion. Distance and language are no longer impediments to collaborations thanks to the Internet, cellular capacity for transmission of information, and increased travel. Microbes have never known geographic boundaries, and today they are even more apt to travel around the world in hours, posing challenges to populations who in the past would never have been exposed. The future of dentistry and oral health demands that professional leadership think and act globally.

The Future of Global Oral Health. Dentistry in the United States must be fully involved in international organizations and activities for research, education, clinical practice, product development and distribution, and health promotion. This involvement requires a commitment to learning from other countries and cultures and creates a mandate for leadership with sensitivity.

The United States will benefit from dentistry’s global involvement. As the demographics of the country continue to change and reflect multiple cultures from around the world, answers to many of the disease management, disease prevention, and health promotion questions will be found through collaborations with other countries. Collaborative networks must be established to facilitate funding and to implement activities related to research, education, and practice. Also, the emergence of common markets increases the need and the opportunity to develop common standards for product development, approval, and distribution.

The profession and its leadership must develop a “global vision”—one fitting the 21st century. Dentistry in the United States cannot be separated from the rest of the world any more than the United States can be separated from the global community. Organized dentistry must provide that essential leadership in international health, for its own sake, as a responsible member of the global community.

Conclusions

Looking to the future and predicting what the oral health needs of our citizens will be, and how to address them, are formidable tasks. It is equally difficult to discern the problems that will confront our profession.

The goal of the 2001 Future of Dentistry report is to help the dental pro-
fession cope with inevitable change, both at home and on the world stage. The findings and recommendations it contains were prepared by experts who came together in a mutual desire to improve oral health by improving oral health care. The report addresses all issues that touch the profession—no matter how sensitive they may be—and insists that parochial views be set aside.

This article but scratches the surface of the issues facing the dental profession. In addressing some of the problems that most affect the practicing dentists, it is intended to stimulate interest and discussion so that all members of the profession can contribute to the process of moving forward.

What trends have been noted and what recommendations for the future have been presented will not come as a surprise to most, nor will they require radical changes in direction. It is a roadmap for the future that will benefit the profession and the public it serves. It is imperative that the journey be undertaken to achieve the ongoing success of the dental profession in fulfilling its responsibility to assure the best oral health for Americans, as well as the population beyond our borders.

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The Future of Dentistry, while commissioned by the American Dental Association, is not a policy document of the organization. It has been designed to reach out to all parties interested in the betterment of health throughout the world and, more specifically, to those who are able to contribute to improving the delivery of dental care in order to achieve the optimal oral health of the public. The Future of Dentistry report was developed by a large group of individuals selected for participation because of their knowledge, expertise and commitment to the welfare of the dental professions and the public it serves. The report was prepared with great independence. The ideas expressed in the report are not necessarily those of, nor endorsed by, the American Dental Association.
Abstract

Popular attention has focused on connections between single nucleotide polymorphisms (SNPs) where single genome irregularities are associated with biological deficiencies. The more significant and more difficult work will come through seeking to understand the proteonomics—the way sets of genes are expressed as proteins, and ultimately in larger and more complex entities. Future developments will take place at the interfaces among various disciplines. We are already seeing the introduction of diagnostic tests based on the new genomics in dental offices. New skills will be needed to bring these emerging developments into practice.

The central dogma of biology—that our genome (composed of DNA) encodes the information needed to create messenger RNA (mRNA) that in turn is required to produce the molecular engines of life, the proteins—has long been held as a key to understanding disease and improving health. With the publication of the draft sequence of the human genome (Lander et al, 2001; Venter et al, 2001), science officially entered the “post-genomic” era. It is widely hoped that the information obtained as a result of the genome project will lead to an integrative understanding and ultimately solution of complex diseases (Austin & Kreiner, 2002; Strohman, but see Rees, 2002; Willett, 2002). In this brief review, we posit that for this new science to impact on dental practice and oral health, oral health researchers must embrace the post-genomic effort and schools of dentistry and professional organizations alike must play a significant role in catalyzing much needed information transfer to the profession.

What Information Will Be Obtained from the Human Genome Project?

The information obtained from the human genome project is permitting investigators to define genetic variation in humans. The most common variations are observed as one-base changes scattered throughout DNA, termed single nucleotide polymorphisms (SNPs). Intensive efforts are underway to determine which SNPs are associated with disease (Taylor et al, 2001). At a minimum, such efforts will lead to more precise tests that will define those most at risk for specific disease or condition. However, given a sufficiently robust curatorial approach to data collection, this strategy will also provide novel insight into the pathogenesis of disease as associations between genes previously thought to be unrelated to a particular disease are uncovered. This has been termed the “hypothesis-free” approach to disease discovery (Altschuler et al, 2000; Brookes, 2001).

Variation in the way humans respond to drugs can also be catalogued using SNPs (McLeod & Evans, 2001). Pharmacogenetic dissimilarity is common, occurring in one in twenty persons; however these disorders are covert in that an individual will only realize an adverse event if exposed to the pharmaceutical (Nebert & Bingham, 2001). In a recent review, Phillips and colleagues (2001) reported that among the twenty-seven drugs frequently implicated in adverse drug reaction studies, 59% are metabolized by at least one enzyme known to have a genetic variant that yields poor
breakdown. Adverse drug reactions should be minimized in the future through consideration of a patient's pharmacogenetic makeup.

Enthusiasm for the advances made possible by unraveling the genetic variation of individuals must be tempered by the many potential ethical dilemmas the availability of such information presents (Nebert & Bingham, 2001). For example, knowledge of an individual's susceptibility to disease or sensitivity to either chemicals or environmental insult could lead to prejudice by insurers and employers. Further, would the availability of every person's ultimate "fingerprint" (their genome) lead to the suspension of the right of due process?

The human genome project will facilitate inventory of all mRNAs, or transcripts, that produce the molecular machines required for most life processes, the proteins. The ability to quantitate thousands of transcripts simultaneously from defined tissue, organ, or cellular samples yields the "transcriptome" (Strausberg & Riggins, 2001; Camargo et al, 2001). Unlike the genome however, this is not a static measure as the transcriptome will fluctuate markedly as function of physiological state.

The level of mRNA does not directly relate to the quantity of protein. The proteome represents the complete catalogue of all proteins within in a cell, tissue, organ, or organism. The solution of the proteome will prove to be considerably more difficult to unravel than the genome. A great deal of surprise was expressed when estimates of the human genome size indicated that there may be as few as thirty-five thousand genes. Viewed in this manner, our genetic blueprint or "genome space" is only about three times as large as the fruit fly, Drosophila melanogaster, and only about five times larger than baker's yeast, Saccharomyces cerevisiae (Pollard, 2002). Proteins, however, are produced in many "flavors" with variation due to alternative splicing of mRNA (where bits of mRNA encoding functional portions of one protein are "stitched" or spliced to others) and decoration of the protein by a bewildering variety of co- and post-translational modifications including carbohydrate and phosphoryl groups. Moreover, proteins can interact with one another yielding complexes with functions distinct from their component parts (Fields, 2001), thus adding greatly to the complexity of the proteome. It appears therefore, that the complexity of the proteome greatly extends our modestly sized genome space. Not surprisingly, the proteome differs markedly among cells comprising tissues or organs and it the proteome is dynamic. The nature and quantity of proteins present are sensitive to the physiological state.

The solutions of the human genome, transcriptome, and proteome will permit investigators to define the molecular anatomy of key tissues, organs, and cells—a quantitative spatial and temporal atlas of all transcript and protein expression. Technological advances have made it possible to truly understand disease at the single cell level (Rubin, 2002). Ultimately, advances in genomics, transcriptomics, proteinomics, and molecular anatomy will enable investigations into complex dynamic systems (Strohman, 2002) such as the signaling networks (Zhu & Snyder, 2002) and metabolomes (Phipps et al, 2002). An integrated understanding of both healthy and pathological conditions will provide the necessary information to rationally solve complex diseases (Strohman, 2002).

**Future Scientific Advances Will Come at the Interface of Traditional Disciplines**

Oral health research that embraces the types of advances outlined above will be required to ensure that the fruits of the post-genomic era "enter the mouth." This will require a new type of interdisciplinary science that will be positioned at the interface of traditional disciplines such as biochemistry, computer science, engineering, genetics, mathematics, and physiology (Fields, 2001). Following are two brief examples of how these new hybrid disciplines can lead to advances that will improve health.

Advances in genomics and proteinomics coupled to successes in tissue engineering will provide new options for tissue repair and replacement. Dissection of the cascade of molecular events required for the formation of a tissue or organ during development uncovers strategies for the repair or replacement of diseased tissue. The phrase "scarcer than hen's teeth" reflects the absence of teeth in birds. In molecular terms, during evolution birds have lost a
number of signals necessary to prompt tooth development. Experimental replacement of key signals such as bone morphogenetic protein 4 (BMP4) induces a tooth-like epithelial bud that invaginates into underlying mesenchymal tissue (Chen et al, 2000). While this stops well short of growing hen's teeth, recapitulation of developmental events does provide a strategy for the regeneration of new tissue.

Classic histological studies of reparative dentinogenesis presaged the existence of odontoblast stem cells (see Karjalainen, 1984 for review). Robey and colleagues have isolated dental pulp stem cells from adult human pulp and have demonstrated that these cells can produce a dentin-like material following transplantation into an animal model system (Gronthos et al, 2000). Such cells could be used to seed biodegradable scaffolds to one-day effect repair of pulpal damage (Alsberg et al, 2001). The scaffolds serve both as a vehicle to retain cells in a given anatomical space but also can be engineered to deliver specific extracellular signals to the stem cells that direct them produce one or more protein products or maintain a specific differentiation state (Griffith & Grodzinsky, 2001). Repair of more complex anatomical structures will doubtless be approached using computer-aided scaffold design (Sun & Lal, 2002).

Advances in genomics and proteomics coupled to successes in bioengineering will catalyze a shift from disease detection to health surveillance. Technological advances have allowed for increasingly sophisticated comparison of the many systemic diseases, infections, hormones, and therapeutic or recreational drugs, including alcohol, that can be monitored using saliva (Tabak, 2001; Kaufman & Lamster, 2002; Streckfus & Bigler, 2002). The anatomical ease with which samples can be assayed, coupled with the miniaturization of “labs on a chips,” makes real-time monitoring of biomarkers, physiological parameters, treatment compliance, and lifestyle choices plausible (Tabak, 2001). While anatomically non-invasive, the ease by which a sample can be obtained does not suspend a person's right to confidentiality.

The Needs to Transfer New Knowledge into Practice
Schools of dentistry and professional organizations must catalyze the infusion of this new knowledge into the profession of dentistry.

which both systemic and oral health can be monitored (Malamud & Tabak, 1993). Several recent reviews document the many systemic diseases, infections, hormones, and therapeutic or recreational drugs, including alcohol, that can be monitored using saliva (Tabak, 2001; Kaufman & Lamster, 2002; Streckfus & Bigler, 2002). The anatomical ease with which samples can be assayed, coupled with the miniaturization of “labs on a chips,” makes real-time monitoring of biomarkers, physiological parameters, treatment compliance, and lifestyle choices plausible (Tabak, 2001). While anatomically non-invasive, the ease by which a sample can be obtained does not suspend a person's right to confidentiality.

The Needs to Transfer New Knowledge into Practice
Schools of dentistry and professional organizations must catalyze the infusion of this new knowledge into the profession of dentistry.

Ready or not, post-genomic testing is entering the mouth. For example, a commercial test for predisposition to severe periodontitis (Periodontal Susceptibility Test, Straumann USA, Walkham, MA) is being used by practitioners despite ambiguities in being able to predict patients at risk (Greenstein & Hart, 2002) As noted in the previous section, a number of tests using oral fluids have been developed.

Dentists and other oral health professionals must be prepared to make informed decisions about the use of new genomic and post-genomic-based approaches to diagnosis and treatment in the future. To function effectively in the new era, the professional must develop the following skills: the acquisition of a basic knowledge of human genetics; the

Schools of dentistry and professional organizations must catalyze the infusion of this new knowledge into the profession of dentistry.

References


Abstract
Three trends that have been with dental education for a number of years are identified: a crowded curriculum, promising growth in the biological understudy of oral conditions, and disparities in access to oral health care among Americans. To address these influences, a restructuring of dental education in the U. S. is proposed. Among the changes called for are bringing biomedical science education in the first two years of dental school to parity with medical school education, increasing the time and quality of extramural clinical education, and adding a mandatory year of postdoctoral education.

During most of the twentieth century, dental education has been shaped by the need to educate its practitioners to treat the consequences of two diseases, caries and periodontal disease. Focusing most of its resources in this direction caused dental schools to narrowly educate its students and, as a consequence, its mission. However, in the latter part of the last century as research and prevention demonstrated that these two diseases could be brought under control, dentistry could begin to accept a larger role as part of the health care system in the United States; hence, dental schools need to prepare its students for a broader role in the health care delivery system. Both the Surgeon General's Report on the oral health of the nation (U.S. Department of Health and Human Services, 2000) and the subsequent American Dental Association's Future of Dentistry Report (American Dental Association, 2001) describe shifts in trends that will influence dental education now and into the future. Recognition of the need to reshape dental education has appeared in recent articles (Bertolami, 2001; Hendricson & Cohen, 2001) urging dental schools to reconsider their current curriculum.

In the 1980s, when findings from NHANES studies first reported the dramatic changes in disease patterns, it became impossible to translate those findings into a need to change education because our capacity to analyze those findings in combination with demographic shifts, technologic breakthroughs, and scientific advances was limited. But now, the changes in disease trends have taken hold, and there is a clearer understanding of how changes in demography, technology, and science are impacting on the profession. The first year classes we enroll in September of 2002 will be at their practicing prime in 2025 when the full effect of the trends now under way will have reached their maximum impact. It is, therefore, time to revisit the influences on dental education, which emerge from these reports and others and place them in the ideological framework of how we must educate our students.

This paper will (1) briefly review the changes in ideology that have brought us to where we are today in dental education; (2) project the directions dental education must take in order to catch up with the advances in dental research, society, and pedagogy; and (3) provide insight into how to shift the curriculum to bring it into harmony with the current trends.

Shifts in Ideology
There are three ideological debates that have acted on student's education. These must be addressed. They are (1) the emphasis given to the biomedical sciences vs. the clinical sciences in the curriculum (2) continual overcrowding of predoctoral education vs. fundamental pedagogy.
reform in educational format and (3) professional responsibility for a limited vs. broaden public service role. How dental education perceives these debates in the context of its education and service missions shapes the format of the student's education and the very nature of the school. These are not new debates, but are fundamental to the profession and must be continually readdressed in light of new scientific findings, technological advances in the field, and societal expectations (Formicola, 2002).

The Biologic Sciences vs. the Clinical Sciences. Dentistry must educate its practitioners and prepare its future faculty and researchers with the same or very similar knowledge in the biomedical sciences as does medicine. Without in depth knowledge in the biomedical sciences, dentistry is in danger of losing its status as co-equal to medicine in health service to the public. Over the past twenty-five years there has been steady erosion of the biomedical sciences in the dental curriculum. The emphasis on the biomedical sciences in the first two years of the curriculum has been reduced in order to provide a greater amount of clinical science information in the first two years. Beginning in the 1970s there was a perceived need to provide students with an early introduction to patients, which up until then had not occurred until the third year of dental school. The amount of clinical exposure in the first two years continued to grow. The didactic and laboratory instruction in the clinical sciences expanded in the first two years to prepare students for this early clinical experience. The notion behind including clinical exposure in the first two years was to reinforce the biomedical curriculum, but instead dental schools chose to give students early exposure in clinical dentistry which has resulted in diluting students education in the biological sciences.

A significant number of dental schools up until the mid-1970s offered the biomedical sciences from departments responsible to teach both medical and dental students. In a number of schools, there were courses taught to joint classes of medical and dental students while, in other schools, separate courses were offered to the dental students by experienced faculty who taught medical students also. In both instances, the scope and depth of the biomedical sciences were quite profound. But as the clinical sciences began to crowd the first two years, students could not keep up the pace of the intensive biomedical science curriculum and, many, if not most, dental schools shifted to find alternate ways to provide the biomedical sciences. As a result, the emphasis in the curriculum in the biomedical sciences has decreased significantly.

However, the scientific revolution and advances in medicine require a rethinking of this de-emphasis now, as we must enable our practitioners to have the same or very similar command of the biomedical sciences, as do physicians. If dentists are to expand the scope of their practices to include greater monitoring of systemic disease and manage the growing number of patients who are being kept alive longer with previously life threatening diseases, then a renewed emphasis is necessary in the biomedical sciences.

If dentists are to expand the scope of their practices to include greater monitoring of systemic disease and manage the growing number of patients who are being kept alive longer with previously life threatening diseases, then a renewed emphasis is necessary in the biomedical sciences.

Overcrowded Predoctoral Education vs. Fundamental Reform. There is a lack of willingness to recognize that the four year dental education can no longer educate all students to high levels of clinical proficiency in restorative dentistry while at the same time educate students in all the important specialty fields of dentistry that have developed over the latter part of the twentieth century. The ideological debate on the em-
all clinical specialty fields and the expectation that all graduates will possess greater and greater information in all fields of dentistry is impossible to achieve within the four years of dental school. We have failed to reconcile, too, in the curriculum the growth in knowledge in clinical dentistry with new societal expectations for the profession. Instead, in an attempt to come to terms with these complex issues, we have developed overcrowded curricula and unrealistic expectations on what students can achieve within the predoctoral curriculum. We have an educational system that is overcrowded because it is based on the assumption that the four-year predoctoral curriculum can educate students to the level of an independent practitioner upon graduation. The time has come to act upon what we know: That is, without a fundamental restatement of what can be achieved by the average student within the four predoctoral years, we will continue to place unrealistic expectations on students and not prepare them for the more complex and complicated practice world that they increasingly face today. Further, the current lock-step design of the curriculum does not accommodate individual student variability in skill and interest wasting the opportunity to use the full talents of the extremely well prepared students we enroll. Educational methodology and a keener understanding of the learning process permit a very different dental education than we offer today. It is time to reformat the preclinical and clinical curriculum and recognize that all graduates require at least one postdoctoral year prior to independent practice.

**Limited vs. Broaden Public Service Role.** The reports mentioned above indicate that the profession of dentistry must pay new attention to the oral health disparity problem in the United States. Dentistry’s obligation for the uneven level of care provided to Medicaid patients by the private practice system and the limited dental public health system has been exposed through the Surgeon General’s report. How does that play out in the dental school and what have been the debates? Up until very recently, dental schools did not pay much attention to their public service role, nor prepare graduates to understand the nature of the profession’s obligation to provide service to the entire public. Only a small percentage of dental school income comes from Medicaid, reflecting that for most of the system the schools are uninvolved with the problems of those living in poverty in the United States. An attitude has evolved among dental schools that the level of care provided in on-site teaching clinics is superior to non-dental school service oriented community settings; therefore, this attitude leads to the policy that on-site clinics are a better place in which to provide clinical experience for students.

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By providing clinical education in settings outside of the school, the dental school must get involved in a broader set of issues then those internal to the school.

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**Table 1. Comparison of Mean Curricular Hours, 1981 and 1997.**

<table>
<thead>
<tr>
<th></th>
<th>1981-82</th>
<th>1997-98</th>
<th>Difference</th>
<th>Weeks of Instruction*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Science</td>
<td>930</td>
<td>839</td>
<td>- 93</td>
<td>- 3</td>
</tr>
<tr>
<td>Clinical Science</td>
<td>3,480</td>
<td>3,942</td>
<td>+ 462</td>
<td>+ 15</td>
</tr>
<tr>
<td>Behavioral Science</td>
<td>224</td>
<td>145</td>
<td>- 79</td>
<td>- 2</td>
</tr>
<tr>
<td>Total</td>
<td>4,636</td>
<td>4,926</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


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**Reformatting Dental Education**

To summarize, then, the changes required in dental schools to reflect these new realities on these three ideological debates are,
• To renew emphasis in the biomedical sciences,
• To reconstruct dental education into a predoctoral clinical education which reflects realistic expectations for graduates and encourages individual growth through a postdoctoral experience, and
• To broaden public service emphasis by connecting a portion of clinical dental education to off-site or service learning.

What would dental education look like if this thinking on these fundamental debates were put into practice? It would be a much different and exciting environment in which to educate the next generation of dentists. Several components of the description to be presented are already ongoing in some dental schools. The description is a composite view of the best approaches a number of schools have already taken to deal with some of these new realities. It draws on the experience at Columbia which implemented broad curricular changes as one of the six schools funded by the PEW Foundation’s Strategic Change program (Formicola, 1991; Formicola & Kahn, 1992; Formicola, Marshall, & Kahn, 1990).

**New Emphasis on the Biomedical Sciences.** In the first two years, the biomedical sciences should be offered to dental students at the same level as they are offered to medical students. Physical diagnosis should become a serious offering and the basis for a stronger clinical education in oral medicine and in care for the elderly and those medically compromised patients. This should become the basis for the dentists expanded role in the monitoring of general health status as part of the increasing scope of preventive practice needed by the public. Early exposure to patients should be designed to reinforce the biomedical curriculum. To accomplish this goal, schools would be required to increase course scope, depth, and content in the biomedical curriculum to at least a range of from 1,000 to 1,300 curricular hours, up from the current dental school average of 840 hours. Basic science instruction in medical school is on average in the range of between 1,000 to 1,300 hours (Danner, 2000). While equalizing the number hours precisely to medical school hours and joint instruction between medical and dental students may be desirable, it is not necessary. However, the current downward spiral of the emphasis of basic science in the dental curriculum needs to be reversed. Instead, this portion of the curriculum should be enhanced. Between 1981 and 1997, basic science hours dropped by almost 10% even though total hours in the curriculum grew by almost 10% (Table 1). As a profession, we cannot claim the same right as medicine to apply the advances in the biomedical sciences, if we are unwilling to educate our practitioners to the same or similar level of competence as medical practitioners. The scope and depth of the biomedical curriculum must be enhanced to achieve this end. The now mostly survey courses in physical diagnosis should be brought up to a higher standard and become the basis for the dentist to monitor general health status for the growing number of elderly in their patient mix at a far greater level than taking a medical history and recording blood pressure as is the current norm.

The impact of these biomedical instructional changes on the current preclinical and early exposure to clinical dentistry coursework now common in many dental schools must be considered. Students do not have infinite ability to absorb everything we are able to squeeze into the curriculum. If the scope and depth of the biomedical sciences is increased, so too must the time available for students to study and learn this important part of the curriculum. The current trend to add more and more clinical dental information in the first two years will necessarily need to give way. Early clinical experiences should be more related to the biomedical curriculum as a carry-through of physical assessment. The preclinical and clinical sciences in years one and two need to be reduced in content and reshaped to be in better harmony with the biomedical sciences.

**Realistic Goals for Predoctoral Education with Complimentary Postdoctoral Experience.** In an attempt to deal with the explosion of clinical knowledge, dental schools added on average an additional 10 weeks or 290 hours of instruction in the same four-year curriculum. In the fifteen-year period between 1982 and 1997, the clinical sciences added 462 hours of new course content, or 15 weeks of additional course work (Table 1). This additional course content was accommodated in the confines of four years by increasing the number of contact hours.

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**Table 2. Dental Schools 1999-2000 Mean Curriculum Hours and Ranges.**

<table>
<thead>
<tr>
<th>Curriculum</th>
<th>Mean</th>
<th>Hours</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Science</td>
<td>837</td>
<td>544</td>
<td>-2,160</td>
</tr>
<tr>
<td>Clinical Science</td>
<td>1,936</td>
<td>643</td>
<td>-2,727</td>
</tr>
<tr>
<td>Behavioral Science</td>
<td>224</td>
<td>4</td>
<td>-1,340</td>
</tr>
<tr>
<td>Total</td>
<td>3,863</td>
<td>2,509</td>
<td>-4,862</td>
</tr>
</tbody>
</table>

and by reducing course content in the basic science and behavioral sciences by 172 hours, or by almost six weeks. What does this mean? It means that if we had not decreased the emphasis in two major subject areas where there was at least equal growth in knowledge to the clinical sciences and had not filled in every conceivable hour in students' schedules, dental school would be four and one half years long. Instead of recognizing that we cannot offer a contemporary education within the confines of four years, we decided to deemphasize two important parts of the curriculum, and overcrowd the curriculum by using every hour imaginable so that students are placed in a poor learning environment. Dental school has always been intense, but it is recognized now to be overcrowded by every study or critique carried out over the past thirty years.

Rather than face the reality that schools cannot any longer complete the process to independent practice within the four predoctoral years, dental schools have pruned unnecessary preclinical laboratory coursework and deemphasized other courses. While the former was much needed as preclinical laboratory instruction was overemphasized in course hours, the latter requires rethinking. This strategy to accommodate needed course content has been followed by most schools. But, schools are still facing the same basic problem of an overcrowded curriculum, a continually growing need to add more content to the curriculum and a demand for students to have gained sufficient clinical experience to prepare them for independent practice upon graduation. The preclinical and clinical education should be regorganized on the expectations that all graduates are required to attend a mandatory one-year postdoctoral experience. Then the undergraduate curriculum can be redefined and enriched with elective and selective experiences so that students may apply their interests and special talents to a variety of career paths in dentistry. The post doctoral year would concentrate on providing students with clinical experience in a variety of clinical procedures and deepening their ability to manage a broader range of patients (Formicola & Myers, 1991).

In reformating the predoctoral curriculum, the following four principles should be followed: (1) Conceptualize the overall curriculum plan to the desired characteristics of the graduates. (2) Harmonize hours devoted to instruction to the conceptual plan. (3) Allow time in the schedule for independent learning and assimilation of information. (4) Use modern teaching modes. Shifting from mainly a passive learning lecture model to incorporate the more active learning case-based teaching has been shown to improve the learning environment in the didactic curriculum and many schools have begun this shift. Using strategies to unlock the preclinical laboratory instruction, such as computer patient simulators and computerized learning modules containing demonstrations of procedures that usually go on in class, can allow for individual learning. Reconceptualizing the curriculum around a list of desired competencies for the graduates is a helpful way to review the complex course work; however, if schools expect to make change, the emphasis that subject matter is given as reflected in the hours of instruction devoted to the major curriculum components must become a prime target of attention. So too must limiting the number of courses offered each semester as course overload leads to fatigued students. There is significant flexibility to shift the emphasis as dental schools already demonstrate a wide range of emphasis. In Tables 2 and 3, it can be seen, for example, that the range in total clinical science hours is between 2,509 and 4,862, and total weeks of instruction range from 132 to 193. This means that there is precedent in place for schools to reconsider their current emphasis. An excellent and extensive literature review on the dental curriculum by Tedesco (1995) provides guidance to faculty as they rethink the curricular plan.

The Curriculum for the Period 2005 to 2025
In the first two years, the curriculum would be organized to provide a biomedical education on a par with medical students. The modes of instruction would include reinforcing small group teaching, the interactive use of cases, and lectures. A curriculum based on disciplines would be replaced by a coordinated biomedical education based on normal systems and progressing in year two into pathophysiology. A substantial course in physical diagnosis would complement the biomedical core and dental students would understand the importance of applying physical diagnosis to their specialty of dentistry. Subjects in the behavioral and social sciences and epidemiology would be integrated into the biomedical core in a manner in which future practitioners would be able to understand the important relationships between illness as it relates to disease and as it relates to behavioral, cultural, and social factors. The psychosocial subject matter would begin during the first two years and carry on into the clinical years.

<table>
<thead>
<tr>
<th>Table 3. Proposed Reformatted Dental Curriculum.</th>
<th>1999-00</th>
<th>2010</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weeks of Instruction</td>
<td>162</td>
<td>156</td>
<td>- 6</td>
</tr>
<tr>
<td>Hours of Basic Science</td>
<td>837</td>
<td>1,100</td>
<td>+ 263</td>
</tr>
<tr>
<td>Hours of Clinical Science</td>
<td>3,863</td>
<td>3,363</td>
<td>- 500</td>
</tr>
<tr>
<td>Hours of Behavioral Science</td>
<td>158</td>
<td>200</td>
<td>+ 42</td>
</tr>
<tr>
<td>Total Hours</td>
<td>4,860</td>
<td>4,663</td>
<td>- 197</td>
</tr>
</tbody>
</table>

NB: PGY-1 adds 1,920 hours of clinical instruction.
as students gained clinical experience. Early exposure to patients would be designed to reinforce the biomedical, psychosocial portion of the curriculum.

To support this portion of the curriculum, schools need to develop close ties to their medical schools and affiliated hospitals and to strengthen their clinical departments such as oral and maxillofacial surgery, pediatric dentistry, and oral medicine and oral pathology. These disciplines are dentistry’s link to the biomedical sciences because they are using that knowledge every day in treating their patients. Dental schools would need to reach out to schools of public health or to departments in the university such as sociology, as well as strengthen their community dentistry departments, the link to the psychosocial sciences. An increase in the number of hours devoted to the behavioral science curriculum would need to follow.

It is clear that dental students need to begin preclinical coursework in the first two years, but that should not be done in such a way as to place the students in the uncomfortable position as to trade off learning the biomedical sciences for the preclinical laboratory. The preclinical and clinical curriculum would be designed around and in full knowledge of research in developing student’s fine motor skill abilities. By placing the emphasis here, schools will create a logical sequence of courses designed first to develop basic fine motor skills and then to apply them to the various disciplines. All disciplines would participate in the basic skill development coursework and the goal of dental school would shift from students learning a variety of clinical procedures to students developing their fine motor skills and learning how to transfer them to different clinical procedures.

But as we move forward we must recognize that we already have a four and one-half year curriculum compressed into four years and that in order to change from an overcrowded curriculum in which students are overwhelmed with too much information and too many unrealistic expectations of what clinical expertise they can achieve, it becomes necessary to decompress the predoctoral curriculum with a complimentary post-doctoral year. The number of total contact hours in the predoctoral years should be reduced by at least 500 hundred hours to create a new learning environment with more time per week for self-learning and to absorb information.

To support a redesigned setting for students to gain their initial clinical experiences, patients in the on-site clinic would become patients of faculty and postdoctoral students or residents. Predoctoral students would assist on these cases until they have shown basic proficiency in diagnosis and treatment planning and basic clinical procedures. Students would gain greater clinical privileges as they demonstrate competence. Patients in the on-site clinics

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Schools would enrich the clinical experience for students in two ways: first with community-based rotations in off site hospitals, public schools, mobile vans, and community health centers and second, in permitting some students opportunities to take substantial electives which could become the precursor of postgraduate studies.

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Table 4. Proposed Shifts in Clinical Science Hours.

<table>
<thead>
<tr>
<th></th>
<th>1999-00</th>
<th>2010</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intramural Patient Care</td>
<td>1,936</td>
<td>1,564</td>
<td>-372</td>
</tr>
<tr>
<td>Extramural Patient Care</td>
<td>224</td>
<td>500</td>
<td>+276</td>
</tr>
<tr>
<td>Didactic Required</td>
<td>1,027</td>
<td>827</td>
<td>-200</td>
</tr>
<tr>
<td>Didactic Elective</td>
<td>NA</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Pre-clinical Laboratory</td>
<td>701</td>
<td>600</td>
<td>-101</td>
</tr>
</tbody>
</table>

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Journal of the American College of Dentists 2002
Departments of the university to private practice experiences. By reducing the number of required didactic hours, elective hours are possible. For a few students, pathways towards specialty training or other degrees should be available.

All of this would become possible by reorganizing through shifts in current emphasis of instructional hours (Table 4) and in the light of adding a postdoctoral year. Adding a postdoctoral year is both possible and realistic. All that is required is a keen understanding on the part of the dental faculty in the U. S. as to the importance of such a year (Formicola, Redding, & Mito, 1999). Some of the changes to the predoctoral curricular are already possible with the assistance of computer based technology which can be applied to self-paced, off-site education and to enhance the relationship between students and faculty through interactive dialogues.

Discussions on merging dentistry into medicine are surfacing once again (Cohen, 2002), but for at least the next twenty to twenty-five years there is neither a need or a desire within both professions for that to happen. Instead, there is a need to once again bring the education of dental students in closer harmony with the curriculum in medical school in the first two years and to reorganize the clinical education for future practitioners into a four year predoctoral curriculum complemented by a one year postdoctoral experiences.

References
External Forces Impacting U.S. Health Care: Implications for Future of Dental Practice

Burton L. Edelstein, DDS, MPH, FACD

Abstract

Prognostication requires extrapolation of existing conditions and trends into the future. Alternative perspectives and starting points will suggest alternative futures. Since dentistry does not exist independently of the larger health care environment, it is useful to start by considering external forces that impact the overall health care system in order to anticipate both short-term and long-term changes in the dental profession. This contribution to the Future of the Dental Profession symposium considers dentistry’s role within the larger health care environment, examines a variety of forces influencing health care—specifically demography, equity, population health, and social determinants of health, identifies likely demands on the profession, and iterates nine likely changes in the profession.

Like other components of the health care system, the dental profession is a multifaceted enterprise that includes components of practice, education, industry, financing systems, public health, research, auxiliary workforce, and licensure, among others. As an independent profession, we dentists tend to view dentistry as an intact and independent system that provides both primary and specialty care and affords a “dental home” for those who seek care. We view dentistry as a system, analogous to and reasonably independent of the medical care system. In contrast, from the overall health care perspective, dental care may be viewed as a renegotiation of professional authority and autonomy while also changing the mix of services that patients seek, and globalization that impacts disease distribution and patterns of care. More im-

Our thesis is that health care, including dental care, will experience a tectonic shift from the current biomolecular model with its focus on individualized health services to a social determinants model with its focus on population health care.

Immediately, four additional external forces impact both the larger health care system and dentistry (Figure). These four—demography, equity, population health, and social determinants of health—are the subject of this paper. Each holds strong promise to influence the future of the dental profession. Our thesis is that health care, including dental care, will experience a tectonic shift from the current biomolecular model with its focus on individualized health services to a social determinants model with its focus on population health care. We further suggest that this shift will be propelled by demographic changes that result in a growing societal demand for equity.

Dr. Edelstein is Associate Professor of Dentistry and Public Health and Director, Division of Community Health, Columbia University School of Dental and Oral Surgery and Founding Director, Children’s Dental Health Project.
Demography. While true that America is aging, it is also changing. Over the next twenty-five years, the U.S. Census Bureau projects that the proportions of minority racial and ethnic subgroups will grow steadily so that by the year 2025 about half (46.7%) of children under five years of age will be minority (Census Bureau, 2002). The very definition of "minority" will be challenged as these population changes unfold. Notably, the fastest growing subgroups have higher dental disease rates and less access to dental services than their white peers (U. S. Department of Health and Human Services, 2000). This will result in a widening of health disparities by race and a likely upturn in disease burden. For dentistry, this will likely mean a reversal of longstanding caries declines. It is also significant that lower income subgroups are growing faster than higher income subgroups (Passel, 2002) and immigration is contributing significantly to population growth. As a result, income, social, and health disparities are widening along with population growth while American culture and cultural norms are changing. Demographer Jeffrey Passell writes, "The situation of children in the future will result from the interplay of trends in racial/ethnic composition, immigrant generations, age structure, family formation, and social and economic change. Each of these can be expected to affect the policies and politics that will ultimately determine the health of children in the U. S. over the next quarter century" (Passel, 2002).

Equity. Racial and ethnic and socioeconomic disparities in health are already a major focus of the government's health care agenda among both major political parties and across federal and state health agencies. The rallying slogan of one major federal health agency, "zero disparities and 100% access" was recently sustained across transition of administrations. This slogan also reflects the goals of Healthy People 2010 which is an official set of federal health targets that envision equity in both health status and health care. A recent report issued by the National Academy of Science’s Institute of Medicine revealed that "Racial and ethnic minorities in the United States receive lower quality health care than whites, even when their insurance and income are the same" (Smedley, Stith & Nelson, 2002).

This well-substantiated disparity in health care based on skin color is not only anathema to claimed American societal values but is untenable as minority populations become increasingly empowered politically.

Population Health. The dental profession is accustomed to considering its performance based on its intrinsic observation of patients' oral health and patients' use of dental services. Clinicians take pride in the quality of service they provide to patients. Through clinical experience, dentists gain an overall awareness of patients' health status and may draw conclusions about the entire population. However, dentistry is less likely to be aware of the oral health and dental needs of people who cannot access care or do not utilize dental services. Thus, clinicians have a "patient perspective" while policy makers and managers who deal with health care policies and programs have a "population perspective."

Clinicians have a "patient perspective" while policy makers and managers who deal with health care policies and programs have a "population perspective."
medical groups that contract to provide health care for defined populations (typically employee groups) have gained a population perspective, but dentists have little reason or opportunity to do so. Nonetheless, payer and consumer demands that health care be more cost efficient, rational, accountable, evidence-based, and systematized have fueled an increased emphasis on health care that is population-based rather than patient-based. This shift is evident in managed care, in health care system consolidation, and in the growing authority of public health as a discipline. Indeed, population health has gained public awareness and appreciation in the face of bioterrorist threats highlighted by the as-yet unexplained anthrax cases which occurred late last year. Individuals see themselves as one among many, as elements of populations that could be adversely affected by bioterrorism. Individuals now look to public health for guidance, protection, and response—not as patients, but as members of the larger population. Two leading federal authorities on US health care, Jo Ivey Boufford and Phillip Lee (2001) write, “The nation faces new health policy challenges that cannot be met without going beyond the current preoccupation with the financing of personal health care and biomedical research that have resulted in a system of medical care...designed for another era.”

These observations, coupled with a growing focus on population health, suggest that future dental care will be about something in addition to the best possible care for individual patients.

Social Determinants of Health. There is growing and disturbing appreciation that health care contributes only modestly to health status. Rather, health care has come to be understood as one component among many that determine health. Additional influential factors include education, personal empowerment, social support, nutrition, health behaviors, physical and psychological environment, opportunities for prevention, and risk management. “Social determinants of health” pioneers, Michael Marmot and Richard Wilkinson have written, “Health is not simply about individual behavior or exposure to risk, but how the socially and economically structured way of life of a population shapes its health. Thus exercise and accidents are as much about a society’s transport system as about individual decisions; and the nations’ diet involves agriculture, food manufacture, retailing, and personal incomes as much as individual

care contributes only modestly to health status.

choice” (Marmot & Wilkinson, 1999). Boufford and Lee add meaning to this observation by stating, “High spending for health care has not produced better health because personal health care is not the major influence on health.”

In short, the growing realization that health status—including oral health status—is influenced by more factors than health care will impact the future organization and activities of the health professions.

Coming Demands on the Dental Profession

Each of these four trends—demography, equity, population health, and social determinants of health—can be expected to impact dentistry while impacting the overall health care system. Demographic changes will raise demands that the dental workforce become more racially and ethnically diverse and that dental care be more culturally responsive. Simple growth will place demands on the dentist-to-population ratio after adjustment for changes in productivity resulting from technologic innovation. One approach to increased productivity may be through a greater role for para-dental auxiliaries, particularly expanded function dental assistants, and perhaps through a new class of technicians.

Demands for equity will pressure dentistry as a profession to provide care to all who seek it and to address the gap between objective need for dental services and elective demand for those services. The profession will likely be increasingly called upon to take responsibility to facilitate access to comprehensive care as well as to become more accountable to health outcomes at the population level.

The concept of population health will likely promote a new professional perspective that is more appreciative of both the entire population and the sys-
the larger team that will include nontraditional providers.

The anticipated shift to a focus on health promotion and wellness delivered through teams organized around health determinants will likely introduce new providers to dental care.

Potential Changes in the Dental Profession

Nine potential changes have been identified based on the four determinants described above.

1. Greater Attention to the Underserved. Public demand arising from demographic shifts can be expected to push government to leverage its funding and authority. This pressure could result in government tying its support for dental education to care for the underserved, expanding the dental safety-net (e.g. community health centers, school- and hospital-based clinics, freestanding publicly supported dental centers), creating incentive programs in Medicaid and the State Child Health Insurance Program, and attempting mandates and taxes to “force” greater service to the underserved.

2. Polarization of Care. At least in the short term, it is reasonable to anticipate greater movement toward two-tiered dental care in the U.S. Low, modest, and even some middle income families, squeezed by growing income disparities, will increasingly be served in safety-net facilities and volume practices while the affluent will be provided with “concierge care” that attends to every convenience and comfort provided at a high out-of-pocket cost. Today’s “executive health” programs, a few of which include dental services, provide a model for such care.

3. Increased Accountability. Both consumers and payers can be expected to demand greater private sector accountability through payment schemes that reward for performance, through greater reporting requirements, and through more available consumer information about particular dentists and their practices. Information systems are also likely to develop capacity for independent dentists to receive feedback on their practice performance, especially relative to other dentists serving the same populations.

4. Refinements in Clinical Practice. Well established health services research techniques, when widely applied to dentistry, can be expected to improve treatment outcomes while enhancing cost-effectiveness, reducing variance between dentists and between different geographic areas of the country, increasing conformity around validated treatments, stimulating development of more professionally developed and endorsed guidelines and treatment protocols, and giving meaning to “continuous quality improvement” in dentistry.

5. Rise of Risk-Based Care and Disease Management. Risk assessment and disease management (rather than surgical repair of disease manifestation) will likely put an end to “one-size-fits-all” dentistry with its rigid twice-annual “recall” paradigm. Rather, diagnostic assessment is likely to lead to staged care that addresses underlying pathogenic processes in preparation for surgical repair and oral health maintenance. Borrowing from medical care trends, dentistry is likely to develop a substantive version of “anticipatory guidance” for young and old and to redefine “primary prevention” to address individual levels of risk. Additionally, disease management will result in treatment goals that include disease suppression and arrest in addition to esthetic and functional repair.

6. Changes in Dental Education Curriculum. Dental education and training will gradually adopt a socio-behavioral and cultural curriculum that will rival its current obsession with biologic and technical considerations. A growing recognition that oral health can be achieved as much through patient engagement and behavioral interventions as through surgical and pharmacologic approaches will create the need for a robust social and behavior science curriculum. One might envision teaching clinics staffed by both dental technical and behavioral experts.

7. Increased Racial and Ethnic Diversity Across the Profession. Consumer demand exercised through advocacy and governmental policy will likely diversify the profession to better reflect the overall makeup of the U.S. population. The pool of minority applicants may be increased, in part, through an enhanced dental school valuation for candidates who bring strong social and behavioral science backgrounds rather than only those who bring strong scientific backgrounds. As the profession engages
social determinants of health and population health as essential components of dental care, it may attract a greater variety of applicants who bring a greater variety of backgrounds and interests to the profession.

8. New Providers. The anticipated shift to a focus on health promotion and wellness delivered through teams organized around health-determinants will likely introduce new providers to dental care. Dentists may work alongside nutritionists, behaviorists, health educators, social workers, and patient representatives to truly prevent and manage oral diseases. Basic restorative care not requiring doctoral level training may come to be understood to be within the capacity of technically trained para-dental providers.

9. New Kinds of Practices. Patient demand and dentist entrepreneurialism will stimulate new kinds of dental practices. Oral health wellness practices will emerge alongside medical wellness and executive practices. Initially these novel practices will likely target those who are at lowest risk for disease, those who already have high commitment to personal health care. Dentists may also elect to co-locate with medical offices to capitalize on private sector marketing advantages, especially for the affluent. In the safety net, co-location may also arise but it will likely do so to further promote services integration and cost-efficiency.

Drivers for Change
Our thesis is that the new demography will lead to changes in representative government and a commensurate increased demand for equity in health care. This demand will stimulate government to adopt policies and redefine programs that can be viewed both as “carrots” and “sticks.” Domains that will be impacted by this new governmental activism may include workforce diversity, insurance coverage, services integration, disease surveillance and reporting, health promotion, and professional education. In fact, these trends are already quite evident in governmental approaches to both social determinants of health and a focus on population health.

Attention to social determinants of health is evident in policies that prohibit smoking in public places, in “Rails to Trails” conversions and bicycle paths that promote exercise, in public education campaigns such as “Back to Sleep” for infants, folic acid supplementation for women of childbearing age, and breastfeeding promotion. They are also evident in food labeling with nutritional content and in a growing movement to regulate the fast-food industry.

Attention to population health is clearly manifest in the federal Healthy People 2010 program and in the Centers for Disease Control and Prevention’s Community Prevention Guidelines in the current administration’s call for dramatic expansion of community health centers, in clinical guidelines like the CDC’s sealant protocols, and in health promotion activities within Head Start, the WIC nutritional program, and maternal and child health programs across the states.

Taken together, these trends, projections, and prognostications suggest a future where continuous improvements in oral health may be gained through more than traditional dental care, where opportunities for health and health care may be shared more equitably across the U.S. population, where society promotes wellness while ensuring needed curative services, and where the dental profession provides equitable dental care for all who need it.

References


The Future of Dental Practice

S. Timothy Rose, DDS, MS, FACP

Abstract
This paper is intended to describe several broad areas of change that will affect dental practice as we enter the early portion of the 21st century. The four major topic areas are: The changing status of American and world society, the demographic changes in the patient and provider communities, technology, and the development of evidence-based dental practice. The article presents a digest of other issues that are encompassed in these four major topic areas that will affect dental practice in the future.

There are four major areas of change that will affect the dental practice in the future. They are:  
- The changing status of the American and world society  
- Demographic changes in both the patient and provider communities  
- Technology  
- Evidence based dentistry

Changing Society
Major events in both the United States and the international community can and will continue to profoundly affect the delivery of health care. The events and social changes following 09/11/2001 dramatically demonstrate the many changes that can occur in our individual and collective lives. These societal changes have a profound effect on many aspects of our economy, which in turn, significantly impact the long-term success of individual dental practices. In the exceptional economic period of the 1990s, while the number of Americans with prepaid dental coverage continued to shrink, the demand for dental services, particularly the more expensive services that are perceived to be either cosmetic or elective continued to expand. When one looks at the last fifty years of the 20th century in times of economic expansion, the demand for dental services increase, while in times of economic contraction, the types and amount of dental services delivery also contract.

These societal and economic forces have created a patient community that is more directly involved in the delivery of their oral health care. They perceive themselves to be more self-reliant and consequently, are more involved in self-treatment. The development of direct to consumer advertising by companies that supply products and services that improve one’s lifestyle or appearance have contributed to this change. The development of direct to consumer advertising by companies that supply products and services that improve one’s lifestyle or appearance have contributed to this change. The evolution of the tooth whitening process, from a treatment delivered by the dentist in their office, to a product readily available over the counter for self-use is a current example of this phenomena.

The advancements in dental science on a worldwide basis has dramatically effected the delivery of oral health care services. Scientific knowledge contrib-
the dental delivery system has not adopted many of the economic, administrative, and restrictive provisions that have changed the medical delivery model. This lack of change has had a stabilizing effect on the dental delivery system. In the future, the development of group practices, changes in referral patterns, and the development of new financing mechanisms will impact the delivery of oral health care.

Demographics and Workforce

The changes that will occur in population and provider groups will be stimulated by numerous interlocking and independent areas of change in both the profession and society. Within the patient community, the demand and delivery of dental care will gradually shift from younger to older patient cohorts. This change will be influenced by the diminished demand for dental care among younger Americans brought about by changing disease patterns, better oral health education programs, and better preventive regimens. The increasing number of aging dentate Americans and their demand for quality oral health care will dramatically change the dental practice of the future. These Americans, from several generations, have been focused throughout their lifetime on the maintenance of their health and appearance. Females will make up a majority of this aging group of patients and they have traditionally used oral health care services to a much higher level than their male counterparts. The continued and growing interest in the relationship between oral and systemic disease (cardiovascular disease, diabetes, osteoporosis, etc.) which are predominately diseases of the elderly, will become major factors in motivating this group of Americans to seek oral health care during their entire lifetime.

As patient population continues to age, there will be a change in disease patterns. Root caries, periodontal disease and mucocutaneous conditions, that are predominately diseases of older patients, will become more important problems.

The interrelationships between the patients’ oral health, their general health, and the medications they are taking, will demand that the dentist of the future possess greatly enhanced diagnostic skills. The issues associated with access to care by geographically isolated groups of patients, by the economically disadvantaged, and the special needs patients, will impact the delivery of oral health care.

Changes in the provider community will also have a profound effect on the dental practice of the future. Gender and diversity issues will affect the provider community. The change in the gender base of the provider community has been occurring over the last thirty years. Issues associated with racial and ethnic diversity within the provider community have not been adequately addressed. A major recruitment effort will have to be launched to significantly effect the racial and ethnic makeup of the provider base. New methods will have to be found to increase the mobility of providers. Issues associated with the licensure system continue to be a major impediment to provider mobility. These are challenges that effect the profession and not the individual successful practice today. But, as the provider base continues to change, the success and longevity of a dental practice will be increasingly influenced by these factors.

Technology

It should be understood that in dental practice, technology is a tool and not an endpoint. Two major areas of technology will affect dental practice in the future: information technology and genetic research. Today, information technology is used to manage the administrative functions within a dental practice. This role will expand in the future. The use of computer technology in the area of diagnostic evaluation will allow the dentist to accurately gather more complete data about the patient's current oral health status. The use of artificial intelligence and advanced computer programs will allow the practitioner of the future to evaluate and use outcomes research in the management of their patients. The use of digital imaging will continue to expand and dramatically change in dental practice. The development of new diagnostic technologies and treatment (an ultrasonic periodontal probe, sophisticated microbiological assays, advanced regenerative procedures, etc.) will be major advancements in patient diagnostic evaluation and treatment. These new procedures will not only be effective at collecting new data, they will be generally non-invasive. The development of these new diagnostic protocols will allow the practitioner to use decision support systems based on known facts derived from the treatment of similar conditions in many patients. This process will lead to outcomes analysis, which will redefine and refocus the treatment and the delivery of patient care, and it will be based on scientific observation and interpretation. To accomplish these objectives, a common nomenclature and diagnostic
Future of Dentistry

coding system will have to be developed and used by the profession. This system will allow members of the dental profession to communicate among themselves and with other members of the health care community.

Information technology will be used to create dynamic communication tools and networks that will help providers transmit patient information. The use of information technology systems will become the preferred medium to deliver continuing education to professionals and will be used to evaluate ongoing professional competencies.

Genetic research, which is just beginning in dentistry, will give the practitioner of the future the ability to diagnose and treat oral diseases and conditions in a much more definitive manner. Rather than waiting for clinical manifestations of the condition to appear, genetic testing will identify these potential problems and supply a means for an effective early definitive treatment.

Evidence-based Dental Practice

Evidence-based delivery of dental care will be one of the most important factors that will drive the dental profession and dental practice in the future. Unfortunately, the evidence-based process requires a particular set of educational experiences to understand how it can be implemented and used. The development of an educational system to train practicing professionals will be very difficult and time-consuming. More likely, the change will occur as a metamorphosis within the dental profession that will begin in the dental educational system and will take a substantial period of time to accomplish.

An educated professional component, with a high degree of professional and scientific skepticism, is essential in making the evidenced-based process successful. As the evidenced-based process is adopted, the delivery of dental care, based on anecdotal information will fall into disfavor. The development of individually based dental care protocols for patients, based on that patient's risk factors, will significantly change patient care. It will allow the practitioner of the future to truly evaluate the current level, degree, and intensity of the patient's oral disease and to develop a precise treatment protocol for that individual patient. These treatment protocols will greatly enhance the level and quality of patient care.

The successful practitioner in the future will face many challenges in a rapidly changing dental practice environment. To be successful a dental practitioner must possess three attributes:
- They will maintain their skills and never become outdated
- They will never stop looking for new knowledge
- Information that is timely, accurate, transferable, and useful will be the underpinnings of a successful dental practice in the 21st century.

The future is bright. The challenges are formidable. Change will be the one constant—but clearly a successful dental practice in the future is an attainable goal.
Challenges and Opportunities for Dental Education, Research, and Service in the 21st Century

Eli Schwarz, KOD, DDS, MPH, PhD, FACD

Abstract
The recent advances in research, technology, and levels of oral health are expected to continue at an accelerated pace. This will place pressures on the curricula, students, and faculty of dental schools; our research infrastructure; and the way we serve diverse segments of the population. Although it is easy to forecast that improvements will come at ever quicker rates, it is less certain how we will react to them.

The future of dental education will be shaped by scientific, technological, political, and economical factors that are in part beyond the profession’s control. Nonetheless, dental educators, individually and collectively have important choices to make.”—(IOM Report, Dental Education at the Crossroads)

It is a humbling thought that the undergraduate dental students that we admit to our dental schools in year 2002 are still likely to be practicing dentistry in year 2040. Having graduated from dental school myself around thirty years ago, many of my contemporaries and I spent a considerable amount of curriculum time in dental school on subjects and topics that had very little application in practice and which to a certain degree was outdated even before we graduated. So, how can we ascertain that the structure, contents, and research base of the dental curriculum to which we expose our students today will be relevant for them in the short term? And how do we encourage the graduates to continuously strive to renew and update their knowledge base in order to be conscientious dental professionals for the future?

During the last couple of years, an exceptional amount of literature has been published, which has addressed the wide range of prevalent problems and issues that exist in dentistry with significant suggestions for the future. Using this and other information, this paper aims to provide some perspectives on future scenarios within our profession as they pertain to our dental education, the research enterprise, and to our service commitment to the community.

Scanning the Environment
Initially, let us consider the environment within which the future dental education takes place. The American Dental Association Future of Dentistry report (American Dental Association, 2001) provided a descriptive framework by examining six areas, the oral health situation in the population, demographic trends, economic trends, scientific trends, financial trends, and industry-specific trends.

Oral health, like general health, has improved dramatically in recent decades. Both the Surgeon-General’s report on oral health (U.S. Department of Health and Human Services, 2000) and the Future of Dentistry report (American Dental Association, 2001) make extensive use of data from the National Health and Nutrition Examination Surveys (NHANES I and NHANES III). Overall, dental caries prevalence has declined, and the proportion of children and young adults who have never experienced dental caries in their permanent teeth continues to increase (Brown, Wall, & Lazar, 2000). Likewise, adult Americans have less decay and fewer fillings in their permanent teeth than ever before, and lower proportions are edentulous (Brown & Lazar, 1998a), although inexplicable differences between states remain (Tomar, 1997). Trends for other oral health conditions, such as periodontal diseases, are more difficult to track because of variations in the way these diseases have been measured, but in general the prevalence and pattern of disease is less serious than was believed ten or twenty years ago. Overall, oral cancer rates are declining, but certain site-spe-
cific oral cancers are on the rise. In general, the health of the nation, including oral health, will continue to improve in the coming decades. Greater awareness of the health effects of lifestyle behaviors, such as tobacco and alcohol use, the value of physical exercise, basic hygiene and the role of diet, will contribute to an increasingly healthier population with increased life expectancy and increased expectations to their oral health care provision (Douglass & Sheets, 2000). These ambitions are also expressed in the Healthy People 2010 document (U.S. Department of Health, 2000), in which each health area, including oral health, is laid out with specific goals and timelines for achieving them.

The recently published Surgeon General’s report pointed out that oral health is essential to the general health and well-being of all Americans and can be achieved by all Americans. However, not all Americans are achieving the same degree of oral health. In spite of the safe and effective means of maintaining oral health that have benefited the majority of Americans over the past half century, many among us still experience needless pain and suffering, complications that devastate overall health and well-being, and financial and social costs that diminish the quality of life and burden American society. What amounts to “a silent epidemic” of oral diseases is affecting our most vulnerable citizens—poor children, the elderly, and many members of racial and ethnic minority groups. This inequality problem has further been studied by the General Accounting Office (U.S. General Accounting Office, 2000) and is of special interest, because of the recent focus on access to dental care from many professional groups.

From a demographic perspective, the overall increase in the population (from around 280 million in 2000 to around 330 million in 2020), the aging of the population, increases in the numbers of people with disabilities, and a rapidly changing race and ethnic profile will require a dental workforce that is confident and competent to address both routine and uncommon oral problems.

These ambitions are also expressed in the Healthy People 2010, in which each health area, including oral health, is laid out with specific goals and timelines for achieving them.

Dental professionals must be equipped to manage the oral health effects of comorbidities and medications, interacting more often with other health care providers, social service agencies, and institutionalized patients.

From an economic and financial perspective the supply of and demand for dental care determine the amount and types of dental services provided, as well as the geographic distribution of dentists, the average income levels of dental professionals, the financial strength of dental practices and the number of applicants to and graduates from dental schools. The robust economy of the past two decades has greatly benefited the practicing dental community. The last genuine economic contraction occurred in 1991, and even that downturn was brief and mild. The ensuing decade has been one of uninterrupted prosperity and steady growth. The present so-called recession is still young, and its ramifications are uncertain. Dental markets have adjusted to supply-side forces by reducing the number of new graduates and to demand-side forces by changing the mix of services provided in response to changing disease patterns, and fee increases have been moderate (Brown & Lazar, 1998b). Overall, a smaller proportion of overall economic resources have been used to provide dental care (Brown, Wall, & Manski, 2002; Wall, Brown, & Manski 2002). Based on the American Dental Association workforce models, the Future of Dentistry report has provided compelling information on the expected changes in the gender composition of the profession and related productivity issues. Taking into account an anticipated increase in the number of women dentists (from around 14% to around 29% of the dental workforce), and accounting for a larger proportion of women dentists working part-time, overall, the national supply of dental services is likely to increase due to enhanced productivity of the dental profession over the next two decades (American Dental Association, 2001a; 2001b; Brown & Lazar, 1999).

The Education Mission
The ultimate goal for dental education is to produce a dental professional, that is able to effectively and empathetically promote oral health and diagnose, prevent, treat, monitor, and evaluate oral, dental, and craniofacial diseases in the broadest context. The three main challenges that will be of importance in the future dental education in order to achieve this goal are how to ensure that the dental curriculum provides the most relevant and updated contents; how to attract motivated and committed students to study dentistry; and how to attract motivated and committed faculty members to teach in the dental school.

The Curriculum. The problem in reforming dental education is not so much achieving consensus on directions for change but difficulty in overcoming obstacles to change (Field, 1995). In many ways, dental education has not changed substantially since its early years, when it essentially began as an apprenticeship and then evolved into an academic discipline with the establishment of the first college of dentistry at the University of Maryland over one hundred and fifty years ago. In fact, in the U.S.A., there is still a major emphasis on technical training, which was exacerbated by the call for a large manpower increase in the 1960s. As a result, dental education detoured from its broader mission as a member of the university community and it has only been in the last twenty years that a refocus and a ref-
commitment as a part of the university values, interests, and culture has been demonstrated and been incorporated into dental education (Haden & Tedesco, 1999).

There has been significant concern that the dental curriculum and system of clinical education, in particular, is not designed to take advantage of the explosion in knowledge in biomedical science and its application to the health of the public. Although there are some examples of innovations in dental education on a global scale that have the capacity to increase the assimilation of basic and clinical knowledge, most of the dental education models are based on a traditional approach to education. This can be seen in the “2+2” model in North America, in the European “3+2” model or the stomatological “4+2” approach. In each of these systems, the basic and behavioral science courses continue to be perceived as hurdles over which students must leap in order to reach the clinical programs where there is little opportunity to use basic science information to advance patient care and treatment. One of my past mentors often claimed that changes in the dental curriculum take at least ten to fifteen years to materialize. This has been reiterated by Valachovic (2000) who stated that “the environment we live in today was created ten to fifteen years ago. The environment we create now will take ten to fifteen years to realize.” Without doubt, the speed with which the average dental curriculum has evolved from the beginning of the 1990s, when the Institute of Medicine conducted their “Crossroads” study to 2001, when the American Dental Association published its “Future” report, has been disappointing slow. Possibly, the impact of the dental profession itself through the Commission on Dental Accreditation on curriculum development—in spite of its beneficial role in setting uniform standards—has also been to limit too adventurous or untraditional curriculum development. This external relationship further complicates the situation at the dental school, where conflicts may arise from demands that are considered relevant from an academic perspective, but irrelevant from a non-university perspective and vice versa.

A need for reform exists because dental education must be responsive to changes in current and projected disease demographics, to advances in science and technology, and to a changing societal culture affecting patient demand for treatment (Bertolami, 2001). Although none of the many recent publications dealing with future challenges in the dental curriculum point to one single solution, the trends seem to be unidirectional, comprising:

- Broader connection between the dental school and its biological or medical counterparts in the university, possibly within the structure of an Academic Health Center,
- Integrated and flexible (individualized) curriculum, preferably problem based learning,
- Evidence-based teaching,
- Early patient contact,
- Increased use of technology, both in relation to computer (Internet) based curriculum materials, and in relation to clinical training (simulation laboratory with computer monitoring and feedback),
- Curriculum time for alternative uses, such as research projects, extramural projects, elective programs outside the traditional dental school,
- Comprehensive clinical training instead of strict discipline based training,
- Team approach involving dental students in collaboration with allied dental personnel, and
- How to balance the rapidly expanding biological and technological and esthetic demands with the increasing need for community-oriented social responsibility (Mandel, 2001).

These trends are not all encompassing, and I have not considered possible resource implications of these. One of the problems of much new development in the curriculum is that it is difficult to measure and generalize. For instance, if the problem-based curriculum works well in the University of Southern California, does that mean that it will work well in the University of North Carolina? And if we want to know whether one curriculum model works more effectively than another, we may realize that it is hard to ensure a completely controlled environment in the dental school, and that the ideal evaluation process may be compromised. However, to the extent possible, future developments should be exposed to in-built evaluation processes that match our basic tenets in evidence-based practice (Coulter, 2001).

The Students. With regard to the students, it is well documented that the number of admitted students to dental education has fluctuated over time and with a decreasing trend. Overall, there are two to three applicants per enrollee position, and it is assumed that this will not change much in the near future (Valachovic, 2000). The gender distribution of the student pool seems to be relatively stable, approximately 35%/65% women/men. Over time, this will result in an increase in women in the profession. The impact of this trend has been addressed above. Although the overall percentage of minority students has increased from 13% to 34% over the last twenty years, the primary increase has come from Asian/Pacific Islander students, whereas the proportion of Black/African American, Hispanic/Latino, and Native American students has only
shown a 2% increase in the same period (Valachovic, 2000). The racial and ethnic
group of dentists has attracted considerable attention in the
dental community lately, because of its
ramifications for the dental school envi-
ronment and for the future diversity of
the oral health workforce and the faculty
members. Although no easy and effec-
tive solution seems to be at hand for the
future, both the Surgeon General's re-
port and the ADA Future of Dentistry
report have addressed the factors in-
volved.

The Faculty. Closely related to the
recruitment of a diverse student body is
the recruitment and retention of a quali-
fied and motivated faculty to sustain the
dental education mission. On the alleged
shortage of faculty at the dental schools
Haden, Beemsterboer, Weaver, &
Valachovic (2000) have expressed that
the shortage of dental school faculty is a
real and present threat to meeting the
goals expressed through the Surgeon
General's report, for dental schools and
their faculties are the very source of a
qualified oral health workforce and play the
central role in scientific advancements
for the improvement of oral health. The
Future of Dentistry report implies that it
would be helpful to know the accept-
able base-rate of dental faculty vacancies
and supports a study to substantiate the
assertion that over three hundred faculty
vacancies are fully funded at the present
time. Haden et al (2000) provide an ex-
cellent summary of the future actions that are necessary to impact both short-
term (immediate to five years), midterm
(five to ten years), and long-term (ten to
fifteen years) strategies to recruit, de-
velop, and retain dental schools faculty. It
is characteristic that the suggestions com-
prise complex models, which depend on
resources from federal as well as state
and local university sources in order to
be successful and also address broad is-
issues, such as the disparities in salaries be-
tween private practice and university set-
tings, the substantial debt burden for
young graduates as they are on the verge
of choosing their future career, and early
recruitment at the K-12 level for dental
students and further for academic ca-
reers. Other concrete proposals to at-
tract and retain clinician/scientist faculty
have been promoted as well (Krebsbach
& Ignelzi, 1999).

The Research Mission
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twenty years, research will lead to new biological therapies for use by dental practitioners. Additionally, advances in molecular diagnostic and imaging technology will likely enhance and facilitate the detection and monitoring of dental diseases. Thus, the dentist of the future will need to have an understanding of fundamental biology in order to provide optimum patient care as novel treatments become available for dental caries, periodontal diseases, and other oral disorders. Recently, Wright & Hart (2002) have forcefully argued that as we move into the post-genomic era and information from the genome projects is put to practical use, it will become increasingly important for dental practitioners to understand human genetics and the rapidly changing methods for selectively and appropriately applying this newly acquired and vast amount of information. The critically important transfer of research-based knowledge and technology to practicing dental professionals has lagged behind the expansion of the knowledge base for the etiology of dental diseases and methods of treatment. There is a need to evaluate and improve the speed and quality of information and technology transferred from the laboratory and other research settings to the public domain (ADA, 2001).

Another aspect of the research mission is the variability of research activity among dental schools. This topic was in focus at a recent NIDCR sponsored conference of dental school deans, entitled “Conducting and Putting Science into Practice: The Critical Role of the Dental Schools.” It became clear that: (1) research and scholarship has an important role in dental education and practice; (2) considerable investments are needed to meet workforce needs and infrastructure requirements for basic and clinical research; (3) recruitment and retention of students and faculty into research careers continue to be of serious concern (as described above); and (4) partnerships are necessary to enhance research in dental schools. As a direct consequence of this discussion, NIDCR has approved in concept a Planning Award for Research Infrastructure and Capacity Building, which has special significance for a range of dental schools that has very little or no research support from NIDCR (using the so-called IDEA program as a model, i.e., providing support for states eligible for Infrastructure Development Enhancement Awards). Other future oriented research actions to support the research missions in more dental schools comprise mid-career support programs for scholars and collaborative research centers between traditionally research active and inactive dental schools. In general, there is a great future potential for dental schools to initiate and be involved in active research, and there seems to be agreement that in order for dental schools to be considered as contributing to the central missions of the university, they must have a research program at a level comparable to or at least approaching those seen in most medical schools (Genco, 1999).

Service Commitment to the Community

The “moment of truth” for the entire dental education and research enterprise is its ability to provide service to the community at large and in particular to the special risk groups in the population. Although the goal of dental education is to train and educate the dental practitioners who will serve the community, in the present context I will consider the service provision in a narrow sense, i.e., the role of the dental school in the provision of dental services to the community.

In most societies, the dental schools have either an implied or a directly defined role as part of the primary health care system to the population. Traditionally, dental students must gain sufficient clinical experience in a variety of technical procedures to become competent entry-level practitioners qualified to graduate and become licensed (Field, 1995). However, there are varied views of the responsibilities of the dental school by different individuals and groups. To indigent patients, the student dental clinic may be the only source of care. Similarly, to politicians, a publicly supported dental clinic may be a vehicle for meeting the needs of the underserved. The general dentist in the community may view the faculty practice plan as a good place to refer patients with complex disease problems. To the administration of a university or an academic health center, the outpatient dental school clinic may be an intriguing costly problem with revenue and cost aspects very different from most medical outpatient clinics, which are parts of a hospital rather than part of a university budget. These varied perspectives challenge dental schools to clearly articulate the value and requirements of their patient care mission (Field, 1995).

It is interesting that the IOM “Crossroads” committee concluded (Field, 1995) that the dental schools had no ethical or practical alternative but to make their programs more patient centered and economically viable. Around ten years later, the Future of Dentistry report expresses that dental schools have the potential to serve as a safety net for the underserved without infringing on the private market sector. This will require the dental school to have senior students, postgraduate students, and faculty providing care in community clinics and practices located in disadvantaged areas. Dental education must include cultural competence and special knowledge and skills to deal with these special populations. Such a view is consistent with the increasing realization described by both the Surgeon General and by the Future of Dentistry reports that there are serious access problems in the dental care system illustrated by the fact that there are twice as many children and young adults without dental insurance compared to medical insurance and for adults older than eighteen years of age, there are three times as many without dental insurance compared to medical insurance. Furthermore, an estimated twenty-five million individuals reside in areas lacking adequate dental care services, as defined by Health Professional Shortage Area (HPSA) criteria. Indeed, it is fair to raise the question whether the many expected scientific advances—even if they are translated into practical clinical
approaches—will reach the people who have the greatest need or whether such advances may even deepen the problems of access to care. Without doubt, the dental schools could play an important role in the fulfillment of some of the ambitions of equalizing the accessibility of dental care. There are obviously very real financial issues that need to be solved for the dental school in this regard, but it is an exciting future challenge to be charged with drawing up a real and integrated addition to the dental care delivery system and in the process provide a necessary patient service, provide a relevant learning experience, possibly utilize otherwise underutilized public resources for oral health care, and thus, contribute to the overall well being of the population.

Conclusion
In conclusion, by 2020, society will experience many scientific and technological breakthroughs, many triumphs over disease, diseases explained by specific genetic factors, advances in bioengineering, increased capacity to promote health, and significant increases in life expectancy. What remains uncertain is the opportunity to obtain optimal health promotion and care for all people, appropriate cost containment, and optimum health care delivery and to have the ability to manage the profound ethical, social, political, and legal issues that accompany the anticipated “biology century” (Slavkin, 1999).

The future role of an individual dental school in the local community must approach these many challenges by being proactive in establishing the salient data basis for planning and implementation to address the concrete needs and demands in its own community at the same time as it actively participates in the greater mission and objectives of its parent university.

The future role of the dental school as an institution in these endeavors is exciting and challenging and the choices made during the next couple of years may contribute to the transformation of the dental school of the last century into the dental school of this century that so many seem to wish for.

References
Abstract
At chairside the dentist is obligated to act primarily in the patients' interests, to fully and honestly inform patients, enable them to make their own treatment choices, and provide competent, continually improving care. Dentists must also recognize that they have a responsibility to reduce existing barriers to access to care in their communities. These long-standing principles of health care practice have found a new expression in the "Charter of Medical Professionalism." The charter is the work of an international consortium that has reviewed the applicability of existing ethical standards to the challenges facing 21st century practitioners and has revised and restated the fundamental principles of ethical health care practice to effectuate a code of conduct for the new century. The author will review professional ethics in the context of the historical doctor-patient relationship, explore how the transition to modern treatment modalities has affected the professional-patient relationship, and will appraise the charter as a valuable resource in redefining dental professionalism for the future.

"The dental profession holds a special position of trust within society. As a consequence society affords the profession certain privileges that are not available to members of the public-at-large. In return, the profession makes a commitment to society that its members will adhere to high ethical standards of conduct. These stan-

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standards are embodied in the ADA Principles of Ethics and Code of Professional Conduct (ADA CODE). The ADA Code is, in effect, a written expression of the obligations arising from the implied contract between the dental profession and society" (American Dental Association, 2001).

Although there is a sizable ethics literature for dental professionals to study and reflect on, it is important for dentists to understand that the ethical relationship between patient and doctor is not discipline-specific but is based on more universal, well-accepted principles such as respect, honesty, caring, and fairness. As a result, it is particularly useful to occasionally look outside our own profession to examine ethical standards that other health professions are formulating.

Of particular interest is the recently drafted Charter of Medical Professionalism, created over the last several years by an international consortium composed of the European Federation of Internal Medicine, the American College of Physicians-American Society of Internal Medicine, and the American Board of Internal Medicine. The authors of this report on professionalism have focused their attention on health care in the new century in a way that few others have done to date; and there is much that dental professionals can gain from consideration of their work.

Based on established philosophies of patient care and doctrines of conduct that have defined the interrelationship between doctors and their patients since earliest recorded history, practitioners of the healing arts have inherited and then conveyed their professionalism to the subsequent generations of caregivers.

While most authorities consider Hippocrates (c.460-380 BC) to be "The Father of Medicine" (Jones, 1923), papyrus records indicate that the practice of medicine was formalized over two thousand years earlier in ancient Egypt. The first recognized physician was Imhotep (c. 2725 BC). Hesy Re (c. 2600 BC) was chief of dentists and physicians to the pyramid builders (McGrew, 1985). Their Egyptian contemporaries spent years in arduous training in the arts of interrogation, inspection, and palpation. Information was available on anatomy, herbal pharmacology, pathology, physical diagnosis, intestinal diseases, ophthalmology, dermatology, gynecology, veterinary medicine, the surgical treatment of abscesses, tumors, fractures, and burns. Dentistry was recognized as an important surgical specialty (Redford, 2001).

More is known of medicine in ancient Mesopotamia. The Law Code of Hammurabi (c.1700 BC) includes several early ethical references to the doctor-patient relationship and the liability of physicians who performed surgery. The "Treatise on Medical Diagnosis and Prognosis" (1600 BC) consolidated several centuries of Mesopotamian medical information. Data were efficiently organized and demonstrated that these practitioners possessed a remarkable ability to observe, categorize, and document. All diseases then recognized were carefully classified and described (Gurley, 1961).

Nonetheless, in the history of medicine and the development of medical ethics there has been no greater single influence than that of Hippocrates and the Hippocratic tradition. The great physician practiced medicine on the Greek island of Cos, built a medical school there, and organized scientific medical practice based on objective observation and deductive reasoning (Lagese, 2000).

The legacy of Hippocrates is established in two venues: first, the Hippocratic Oath, an expression of a physician's obligations and duties (Temkin, 1967) and second, the Hippocratic Corpus consisting of about sixty treatises detailing considerable clinical experience, theories of disease causation, epidemics, treatment of wounds, surgery, the law, physician behavior, and responsibilities (Jones, 1923).

From the time of Hippocrates until well into the 20th century, the association between physician and sufferer was rarely the product of the physician's capacity to cure illness, but centered on the comfort derived from the attention and concern of the doctor and his or her ability to give informed advise about the condition, the course of the disease, and its prognosis. As recently as the first third of the past century, the physician's treatment continued to consist of working through the malady with the patient, advising, and consoling. The doctor's role was not unlike that of a knowing clergyman to his parishioner, a bond built more on trust and faith than on the ability to actually change the course of illness. It was a patently paternalistic relationship because it was the doctor who understood the disease, the person, and the family dynamics and who supplied personal caring. At the time this represented all that could be done, and it was certainly welcomed.

The Birth of Modern Medicine. In March of 1942, Anne Sheafe Miller was near death at New Haven Hospital suffering from what was then a com-

Without valid therapeutic options, the patients could not act against their self-interest, act out of ignorance of the consequences, fail to weigh consequences, or, out of carelessness, fear, depression, irrationality, or ignorance construct artificial barriers to a treatment.

A History of Medical Ethics

Before examining the main points of this charter, however, it will be helpful to refresh our memories on the history of ethics in the healing professions. While medical ethics has a recent literature markedly larger than dentistry's, because of the commonality of the two disci-
monly fatal streptococcal infection. She had been in hospital for a month, was often delirious, with her temperature spiking to 107. All attempts to treat her had failed. As she continued to slip in and out of consciousness, her desperate doctors were able to obtain a small amount of an obscure experimental drug and injected her with it. Her hospital chart, now at the Smithsonian Institution, registered a sharp overnight drop in temperature, and according to The New York Times, by the next day she was no longer delirious and was soon eating complete meals (Saxton, 1999).

Mrs. Miller's life was saved, as were the lives of millions of others suffering from bacterial infections, by penicillin, the first, major, effective antibiotic. The Times story went on to report that the news of Mrs. Miller's complete, apparently miraculous recovery spread rapidly and inspired the American pharmaceutical industry to begin full production of this new wonder drug.

With this single event, the practice of medicine had, in that instant, profoundly changed. It was no longer a knowing and compassionate craft, primarily dependent on a physician's ability to diagnose disease, his or her knowledge of the probable course and outcome, and the doctor's personal skill at offering aid and comfort. On that day in March 1942, medicine had been transformed into a modern science, an information-based discipline, increasingly technocratic, and progressively equipped with the methodology and tools to effectively treat and cure disease.

As a direct result, the historic relationship between the treating professionals and their patients also began to change. When there were no alternatives, patients had little choice but to obediently listen and comply. Absent effective treatment modalities, there were no separate risks to consider, therapies to accept, refuse, or to withdraw from. Dentists practicing in the 1930s either restored teeth with primitive, foot pumped drills capable of 350 rpm or extracted. By middle age, the average American had already been outfitted with complete maxillary and mandibular, vulcanite dentures.

Without valid therapeutic options, the patients could not act against their self-interest, act out of ignorance of the consequences, fail to weigh consequences, or, liable for failing to obtain adequate informed consent from patients (Faden, 1986; Mohr, 1905; Schoendorf, 1914; Canterbury, 1972) and by successes in

The folksy familiarity of the Norman Rockwell physician is gone, replaced by professional expertise and efficiency on the one side and a more independent and frequently better-informed patient on the other.

The use of medical information available in the media, the growth of patient empowerment was inevitable.

On the other hand, given the magnitude of medical information currently available and the quantity of new data being generated, it might be supposed that today's patients would be overwhelmed by the complexity of medical care, and, as a result, be forced to place greater reliance on their doctor. It might even be anticipated that paternalistic behavior by physicians would be enhanced at the expense of patient autonomy.

Actually, the very opposite has occurred. As medicine became more and more complex and the variety of treatment choices increased, a concomitant change in the doctor-patient relationship occurred. Because more information was available to patients, their knowledge of disease increased. Better able to understand the choices available, they increasingly aspired to take control of the course of their own treatment. As patient involvement grew, an equal and correlative adjustment in the role of the physician took place.

Paradoxically, it was only when medicine became truly efficient in its ability to scientifically control disease and prolong life that this paradigm shift occurred. Medical care, by becoming more and more technocratic, served to "medicalize" treatment and caused physicians to increasingly run the risk of being viewed as only technicians perfunctorily servicing the particular needs of their patients.

To the average practitioner, accustomed to wide authority and almost
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paternalism of the past. Ozar and Sokol point out that these pronouncements define the dentist’s specific obligations as professionals (Ozar, 1994). Rule and Veach list, in order, respect for patient autonomy, nonmaleficence (do no harm), beneficence (do good), and justice as dentists’ responsibilities (Rule, 1993). Garrett, Baillie, and Garrett identify autonomy and informed consent, beneficence and nonmaleficence, distribution, confidentiality and truthfulness as basic principles of ethical practice (Garrett, 1998). The Principles of Ethics and Code of Professional Conduct of the American Dental Association closely follows these formulations (ADA, 2001).

Charter on Medical Professionalism

As the twenty-first century commences, there is now general acceptance that the ideal is a cooperative partnership between doctor and patient in treatment decision-making. Emphasis is placed on the autonomy of the patient and on scientifically demonstrable evidence as the basis for patient care.

Understanding that the time has arrived to review the ethical principles of practice, an international consortium was established. After several years of study, its final report, called the “Charter on Medical Professionalism,” was issued in February 2002. In the document the consortium members explain that throughout the industrial world, political, legal, and economic forces were challenging medical professionalism and the duality of the doctor-patient relationship. They also support the view that ethical patient care embodies principles that are universally applicable and are common to all modern world practitioners who “... share the role of healer, which has roots extending back to Hippocrates” (Medical Professionalism Project, 2001). Reuters News of London reported that the charter was “… a new professional code of conduct” and “… An update of the nearly 2500 year-old Hippocratic oath designed to help doctors meet the needs of patients in the 21st century” (Reuters, 2002).

The charter’s expression of professionalism is based on three fundamental principles of practice followed by the ten specific responsibilities required to effectuate an ethical practice and summarized below. For those interested in the complete document, the charter can be found in either the Annals of Internal Medicine, 2002, volume 136 or Lancet, 2002, volume 359. The complete work is also available on the Internet at either: www.annals.org/issues/v136n3/full/200202050-00012.html or image.thelancet.com/extras/10522web.pdf.

What follows in some detail is a comprehensive review of the contents of the charter.

**Fundamental Principles.**

**Principle of Primacy of Patient Welfare:** Foremost is dedication to serving the interest of the patient, uncompromised by market forces, societal pressure, and administrative demands.

**Principle of Patient Autonomy:** There must be unequivocal respect for patient autonomy. Paramount is the patient’s informed decision making concerning their care. Choice must be based on honest information and is to be respected and followed so long as the treatment decision conforms to accepted standards of practice and standards of ethically appropriate care.

**Principle of Social Justice:** Every effort should be made by the profession to eliminate unfair distribution of health care resources and to eradicate discrimination based on race, gender, social, or economic status, ethnicity, religion, or any other social category.

**A Set of Professional Responsibilities.**

- **Commitment to Professional Competence:** Professionals must engage in lifelong learning to maintain their knowledge and clinical skills. In addition, the profession itself has specific responsibility to provide the means to ensure that all of its members are competent.

- **Commitment to Honesty with Patients:** Doctors must be sure that patients are honestly informed before treatment is consented to and after treatment has occurred. While knowledge of every detail is not required, they must be the ultimate determiners of the course of therapy. When errors that injure do occur, failure to promptly inform the patients seriously compromises patient and societal trust. Reporting and analyzing these mistakes provides the basis for appropriate prevention and improvement strategies and for appropriate compensation to injured parties.

- **Commitment to Patient Confidentiality:** Maintaining the trust and confidence of patients requires appropriate safeguards to disclosure of patient information, including discussions with persons acting on a patient’s behalf. Confidentiality is more pressing now than ever before due to the widespread use of electronic information systems for compiling patient data and an increasing availability of genetic information. Occasionally, confidentiality must yield to overriding considerations in the public interest (for example, when patients endanger others).

- **Commitment to Maintaining Appropriate Relations with Patients:** Given their inherent vulnerability and dependency, patients...
should never be exploited for any sexual advantage, personal financial gain, or other private purpose.

**Commitment to Improving Quality of Care:** In addition to maintaining clinical competence, doctors must strive with other professionals to reduce medical error, increase patient safety, minimize overuse of health care resources, and optimize the outcomes of care. Doctors must also actively participate in the development of better measures of quality of care and the application of quality measures to routinely assess the performance of all individuals, institutions, and systems responsible for health care delivery. Both as individuals and through their professional associations, they must assist in the creation and implementation of mechanisms to encourage continuous improvement in the quality of care.

**Commitment to Improving Access to Care:** The availability of uniform and adequate health care is the objective of all health care systems. Professionals must strive individually and collectively to reduce barriers to equitable health care based on education, laws, finances, geography, and social discrimination. This commitment to equity entails the promotion of public health and prevention, as well as public advocacy without concern for the self-interest of the doctor or the profession.

**Commitment to a Just Distribution of Finite Resources:** While meeting the needs of appropriate allocation of resources requires scrupulous avoidance of superfluous tests and procedures. The provision of unnecessary services not only exposes one’s patients to avoidable harm and expense but also diminishes the resources available for others.

**Commitment to Scientific Knowledge:** The professional’s contract with society is based on the integrity and appropriate use of scientific knowledge and technology. Practitioners have a duty to uphold scientific standards, to promote research, to create new knowledge, and to ensure its appropriate use. The profession is responsible for the integrity of this knowledge, which is based on scientific evidence and clinical experience.

**Commitment to Maintaining Trust by Managing Conflicts of Interest:** Professionals and their organizations have many opportunities to compromise their professional responsibilities by pursuing private gain or personal advantage. Such compromises are especially threatening in the pursuit of personal or organizational interactions with for-profit industries, including equipment manufacturers, insurance companies, and pharmaceutical firms. Practitioners have an obligation to recognize, disclose to the general public, and deal with conflicts of interest that arise in the course of their professional duties and activities. Relationships between industry and opinion leaders should be disclosed, especially when the latter determine the criteria for conducting and reporting clinical trials, writing editorials or therapeutic guidelines, or serving as editors of scientific journals.

**Commitment to Professional Responsibilities:** Professionals are expected to work collaboratively to maximize patient care, be respectful of one another, and participate in the processes of self-regulation, including remediation and discipline of members who have failed to meet professional standards. The profession should also define and organize the educational and standard-setting process for current and future members. There are both individual and collective obligations to participate in these processes. These obligations include engaging in internal assessment and accepting external scrutiny of all aspects of their professional performance.

**Discussion**

While the existing literature in dental ethics and health care ethics broadly addresses many of these same themes, as do the codes of ethics of most health care professional organizations, the charter offers a valuable restatement and restructuring of the ethical principles of health care practice. Emphasis is significantly altered with the shifting of the usual central role of the practitioner to the primacy of the patient and the stressing of the professional’s obligation to society. For example, the charter envisions social justice and elimination of unfair distribution of health care to be one of its three basic principles. In contrast, the concept of equitable access to care is not even mentioned in the ADA’s Code of Ethics.

Recognizing that in the near future the health professions will encounter ever increasing challenges and frustrations, this forward-looking document establishes in response, a new, activist professionalism, that aims to address shortcomings of our existing health care system and to rectify its perceived inequities. In particular because practitioners’ values are facing an ever more questioning and suspicious society, advancing the patient’s interests to paramount and expressing dedication to social justice will serve to effectively refute those who now confront the health professions. In their formulation of the charter, the framers rely on three fundamental principles to express themes common to all of the healing arts: the patient's welfare, the
patient's autonomy, and the profession's obligation to promote social welfare. The principles are simple and direct.

**Primacy of Patient Welfare.** As early as 1991, The Harvard Medical Practice Study concluded, “There is a substantial amount of injury to patients from medical management, and many of the injuries are the result of substandard care” (Brennan, 1991). A study by the highly respected Institute of Medicine, a branch of the National Academy Sciences reported: Health care in the United States is not as safe as it should be — and can be. At least 44,000 people, and perhaps as many as 98,000 people, die in hospitals each year as a result of medical errors that could have been prevented, according to estimates from two major studies. Even using the lower estimates, preventable medical errors in hospitals exceed attributable deaths to such feared threats as motor vehicle wrecks, breast cancer, and AIDS (Institute of Medicine, 1999).

According to the Joint Commission on Health Care Organizations, since 1998 the number of operations performed on the wrong surgical sites or wrong patients has increased dramatically in the United States (Joint Commission, 2001). The Chicago Tribune reported that in hospitals, meticulous hand washing alone could prevent the deaths of up to 20,000 patients a year from in-house infections (Berens, 2002). While a search of the literature does not reveal similar studies addressing errors in the dental office, it is not unreasonable to suggest that mistakes such as restorative opening into or extraction of the wrong tooth, mechanical pulpal exposures, unwarranted endodontic care, missed diagnosis of periodontal disease, inaccurate orthodontic diagnosis, and faulty treatment plan do occur. If such mistakes happen just once or twice a year per dentist, the result would total over 200,000 errors annually.

**Patient Autonomy-Informed Consent.** Respect for the patient requires that prior to treatment they receive honest and accurate information. Unfortunately, the efficacy of many of today's commonly used medical procedures is being questioned. Evidence justifying the effectiveness of routine mammography is in question (Kolata, 2002). An international panel of experts found that a standard hormonal replacement therapy for postmenopausal women did not, as widely represented, “…Prevent or mitigate heart disease, Alzheimer's, severe depression, bone fractures from osteoporosis, and urinary incontinence” (NY Times, 2002). Research supporting the use Celebrex and Vioxx, the more expensive medications prescribed to treat arthritis, supposedly because of fewer gastrointestinal complications, has been found to be flawed and no such advantage is evident (Jini, 2002).

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**Principle of Social Justice.** While there are more practicing dentists than ever in the United States, and there are more patients seeking dental care, there is a critical shortages of dentists in the Plains as well as less populated sections of northern New England and the fast-growing suburbs of the southwest. According to Dr. David Born, professor and director of the division of health ecology at the University of Minnesota Dental School, “Overall oral health is going to deteriorate” (Wilogren, 2002).

Recent stories describe a number of physicians are now operating and franchising “concierge” or “boutique” practices featuring such amenities as twenty-four hour cell phone access, same-day care, and perhaps as many as 98,000 people, die in hospitals each year as a result of medical errors that could have been prevented, according to estimates from two major studies. Even using the lower estimates, preventable medical errors in hospitals exceed attributable deaths to such feared threats as motor vehicle wrecks, breast cancer, and AIDS (Institute of Medicine, 1999).

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appointments, and house calls and are charging up to $20,000.00 per year per family over and above treatment costs (Belluk, 2002). How different are these practitioners from dentists who inflate fee schedules to maximize their personal incomes, insisting that they cannot render "quality care" unless properly reimbursed? As a profession, are we not concerned that vast areas of our nation are increasingly underserved and that a majority of practicing dentist will not participate in their state's Medicaid programs?

Missing-Do No Harm. Thankfully, the charter has finally discarded the outdated and much abused principle of nonmaleficence ("to do no harm"). Many believe (incorrectly) that the concept has its origin in the Hippocratic oath. The Latin phrase, Primum non nocere (above all else, do no harm), is frequently cited and believed to be a major component of the oath. The phrase does not appear in the oath. The confusion may have arisen from the fact that during the time of Hippocrates, physicians could be used to administer (for a price) fatal potions to dispatch certain unwanted individuals to the afterlife. Hippocrates strongly disapproved of these Hellenic hit men and did include in the oath the phrase, "I will neither give a deadly drug to anybody if asked for it, nor will I make a suggestion to this effect."

Further, it is likely that "do no harm" is a distorted phrase that has been taken out of context. According to John Morrison, MD, a physician and scholar of Greek antiquity, the phrase is not from the Oath but from the Hippocratic Corpus, "Of the Epidemics," Book I, section 11, 5 which states, "Practice two things in your dealings with disease: either help or do not harm the patient."

(The Greek phrase is, "askein peri ta nosemata duo: wphlein e me blaphen.") (Morrison, 1998). Obviously, what Hippocrates had in mind was that physicians are there to help the patients, but if they are unable to help, the doctor should take care not to harm.

The significance of the distinction cannot be overlooked. If a modern practitioner believes that treatments are ethically acceptable so long as they "do no harm" to the patient, then it follows that ineffective therapy is morally permissible.

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no harm" to the patient, then it follows that ineffective therapy is morally permissible. Over-treatment, superfluous tests, and unneeded procedures would also be justified so long as no harm results. Since a profession that foolishly clings to such a concept will ultimately face a justified storm of public indignation, the charter calls on doctors to "scrupulously avoid" such practices.

Conclusions

Unfortunately, many in the forefront of health care leadership seem to be oblivious to the escalating societal challenges that threaten our professional values. In their millennium issue, the editors of the prestigious New England Journal of Medicine commented: "It is hard not to be moved by the astounding course of medical history over the past thousand years. No one alive in the year 1000 could possibly have imagined what was in store. Furthermore, medicine is one of the few spheres of human activity in which the purposes are unambiguously altruistic—in itself, a remarkable achievement" (New England Journal of Medicine, 2000). Such unfortunate self-aggrandizement evidences an appalling lack of sensitivity to the realities of the 21st century embodied in calls for patient primary and the need for equitable access to health care.

The charter is a refreshing and welcome response to the New England Journal's naiveté. Our own profession would do well to reflect carefully on the Charter on Medical Professionalism as it looks forward to the new century before us.

References


Mohr v. Williams (1905). 104 NW 12 (Minn).


**Online Ethics Resources**

http://www.cwru.edu/med/bioethics/bioethics.html—Center for Biomedical Ethics, Case Western Reserve University

http://www.bcm.tmc.edu/ethics/—Center for Ethics, Medicine and Public Issues, Baylor College of Medicine

http://www.uiit.edu/departments/csep/—The Center for the Study of Ethics in the Professions (CSEP) at the Illinois Institute of Technology

http://www4.clevelandclinic.org/education/bioethic/—Department of Bioethics, Cleveland Clinic Foundation

http://www.ethics.harvard.edu/pubs/newsletter/—Harvard University Center for Ethics and the Professions: Newsletter

http://www.thehastingscenter.org/—The Hastings Center

http://www.ornl.gov/hgtnis/elsi/elsi.html—Human Genome Project Information, Ethical, Legal and Social Issues

http://www.georgetown.edu/research/kie/—Kennedy Institute of Ethics, Georgetown University

http://www.va.gov/vhaethics/—National Center for Bioethics, Veterans Health Administration


http://www.bioethics.gov/—The President's Council on Bioethics
Some practices "wing it." Some pick outcomes after the fact in order to look good. But neither of these approaches creates much confidence that next year will be okay, let alone better. Using measurement to improve practice requires understanding the interplay among mission, vision, core values, key success factors, and performance indicators. Combined intelligently, these five elements drive strategic planning and budgeting. They also lead to monitoring progress toward success. This is best done with a balanced scorecard that includes leading and lagging indicators of mission and vision. Indicators should be sampled to represent the practice and monitored against targets to propel the practice toward success.

The characteristics of some dental practices are well understood by their owners. They know how much income is generated by various insurance plans, how much inventory is likely to become obsolete before being used, when the payback time will be reached for the new air abrasion unit, and what proportion and what types of patients decline, delay, or scale back offered treatment plans. Other practices "float." They get along fine because the economy is good. When talking to colleagues, such dentists can come up with reasonable sounding answers to specific questions about the health of the practice—although sometimes the responses are years out of date or largely fabrications chosen to reflect an assumed norm or create a desired impression. Sometimes numbers are chosen after the fact to justify a questionable action or create a positive impression. Intuition and "gut feeling" work very well in good times. A few dentists are simply afraid to keep score in any intellectually honest fashion because they are afraid they may not be winning.

This article is for dentists who enjoy precision in running their practices as much as they enjoy the precision of a well-made crown. It is not about picking winners and losers or meeting somebody else's standards. It is about getting control, increasing understanding, and using numbers to make sure that the practice is healthier next year than it is today.

Landmarks

The character of an organization and its future can often be read from the list of things it measures on a regular basis.

The mission statement answers the question, "Why does this particular organization exist?" It's the organization's business card—it lists the essentials and creates a favorable first impression. Mission statements should meet the following criteria: (a) state the most important things the organization does, (b) define the organization as being unique, (c) be inspirational and memorable, and (d) be brief (remember, it is a business card, not a résumé). The mission of American College of Dentists is "Promote excellence, ethics, and professionalism in dentistry." Almost all of the programs of the College promote this mission and it is the only

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Leadership

professional organization that defines itself this way. The mission is inspirational and it is short and clear enough to be quoted from memory.

Missions are normally written by a single individual who is the leader or is among the leadership group in the organization. Consultants are of little help.

**Vision.** Organizations are moved by vision. Research on individuals who have achieved conspicuous success in their lives reveals a common theme of setting distinct and realistic goals.

Typically, organizations set their vision statement five years in to the future. Vision statements are more detailed than mission statements and they typically run from twenty-five to fifty words of very specific and concrete language. Watch out for the clichés. “Number one

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<th>Concept</th>
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| Mission | Define why organization exists | We make your family smile  
XYZ offers patients choices of the most current technology and the latest science for oral health  
Our office helps you keep your teeth for life |
| Vision | How the organization will look five years from now | Our office will move from an emphasis on repairing the damage of oral diseases to managing the risks associated with disease. We will incorporate (a) a full range of diagnostic assessment; (b) surgical, chemical, and counseling treatments; (c) comprehensive monitoring and management of patients; and (d) a coordinated team approach. We will use information technology in diagnosis, record keeping, and decision support. |
| Core Values | Expected behavior and orientation of the practice | Patients come first  
Maximize the dentist’s take home  
Freedom of choice for patients and professionals  
Admit mistakes, correct them, and learn  
We are glad to see you |
| Key Success Factors | Critical few determinants of practice success | General and local economy  
Age and health of patient pool  
National trends in financing health care  
Evolving dental technology  
Changing oral disease patterns and desires |
| Performance Indicators | Representative samples of the organization’s vital signs | Accounts receivable  
Hours of CE courses  
Rework  
Unfilled chair time  
New procedures added in past year |
Innovative leader ...” say everything. Vision statements are not committee work. This is something for top leadership, supported by large amounts of consultation and expert input. Core Values. These speak to the way things are done. An office might be friendly, professional, upscale, or efficient. A place where every member of the dental team achieves career fulfillment might be a core value. Using the latest technology could be a core value, but following only well-established procedures could be an alternative. Some practices value open communication, others emphasize fiscal integrity, while yet others operate to maximize the dentist’s personal income. Organizations generally have between six and eight core values. Each practice will have a unique set, but they should be consistent, and they should be part of the daily life in the office. Core values are the touchstones of decision-making. Sure sign they are operational is occasional surprise. For example, a front desk staff member might say, “Are you sure we want to reappoint all those patients to free up your Thursday afternoon so you can meet your college classmate?” or “We had better make sure stability and to guide growth. Practices keep charts on patient health: they should keep a chart for their own health. One obvious example is the balance in the checkbook. But that should not be the only measure. The character of an organization and its future can often be read from the list of things it measures on a regular basis. Goals and objectives fall into this category. Objectives describe outcomes in sufficient detail for others to determine whether they have been reached. They are usually quantitative because that is the easiest way to ensure agreement. There is always a date by which objectives are to be reached. Goals are open-ended objectives. They create an expectation about which direction things will be going but no commitment about destinations or anticipated arrival. Stretch objectives are audacious performance targets. Their purpose is not the satisfaction of proving one can think big, it is to force individuals to reorganize their approach to work because the stretch objective cannot be achieved by working harder. Performance indicators are samples of the organizations health and growth: they are not the definition. Some people resist measuring their own or their organization’s performance because they can not find any single measure or any reasonable combination of several measures that completely defines everything they are looking for. That’s a little like eschewing peri probings on patients because six measures per tooth may still fail to detect some bone loss. Selecting the right performance indicators is not an easy task, and this process will be discussed in detail in the section below on balanced scorecards. Setting goals and objectives should never be delegated entirely to individuals who will be performing the work. Don’t ask the hygienist how long each appointment should be. Don’t ask the staff what the optimal inventory of supplies is. A collection of such goals does

Organizations that succeed stay close to their key success factors and avoid flights into the irrelevant.

But in the end, all of the borrowed advice and formulas must bow down to personal judgment.
not describe an organization: it is a hodge-podge of individual wishes and an invitation to compete for resources. Choosing performance indicators and setting realistic levels is always a three-way conversation. The leader articulates the overall direction for the organization and ensures coordination among the indicators. Those responsible for achieving the indicators state what is possible and what is important for their own personal growth. The third party is external to the organization. It is the average level of performance achieved by similar organizations, economic and demographic trends, information about new equipment and ways of working, and best practices benchmark data from outstanding comparable practices. These data require some effort to assemble, but anyone who tries to set levels of performance in a vacuum or based on wishful thinking gets exactly what they deserve—a free-floating organization.

**Strategic Planning**

Let’s put the five elements in Table 1 together to see how they work to improve organizations such as dental practices. The mission statement and core values provide stability and identity. The vision statement provides impetus for change. The need for constant realignment with key success factors also stimulates change. Both faithful execution of the mission and progress towards the vision are guided and monitored through performance indicators.

When these elements work together in a dynamic fashion, they produce three results: (a) a strategic plan, (b) a budget, and (c) a balanced scorecard.

Planning identifies the activities that will change an organization. It is the map that makes clear what actions need to be taken. If the organization is out of balance with its mission some changes will be needed to correct the problem. Vision statements beg for such plans. When plans are large and general, they are referred to as strategy, and when they are limited in scope and time and when they are reactive to unforeseen circumstances, they are called tactics. I have discussed the process of strategic planning in a previous leadership column (1996, Number 3). The newest thinking on the topic places emphasis on clear alignment with the handful of most powerful influences on the organization and remaining faithful to one’s identity. As organizations move from what they are to what they want to be, they must honor the key success factors and their core values.

A second result of planning is a budget. Budgeting means differential investment of resources in various activities designed to improve the organization. It is sometimes confused with the process of finding funds to cover costs—a process so retrograde that it deserves a name like “making ends meet.” Each plan needs a budget. Budgeting is a large enough topic to deserve its own treatment in a leadership column, but the quick and dirty approach is to list each of the plans for a coming year on a piece of paper. Make four columns to the right of each plan and label these columns “dollars,” “time,” “technology,” “know how,” and “authority.” Fill in the five columns for each plan, being as honest as possible.

If the plan is to have one of your auxiliaries provide expanded services to patients, the resources invested could include new equipment and even slight modifications to the office routine and formal training for staff. That means there will be cash outlays to be recorded in the dollars column and there will be time involved for the dentist setting up such a program, supervising the training, and monitoring progress. Don’t forget the final column: a private agreement must be reached with the auxiliary given new responsibilities redefining his or her role and what can reasonably be expected from others in the office. Changing authority in the office can be a huge cost, but assigning responsibility without authority is often more expensive yet.

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**Table 2. Example of a Budget Planning Sheet for Investing in Achieving the Practices Vision.**

<table>
<thead>
<tr>
<th>Initiative</th>
<th>Dollars</th>
<th>Time</th>
<th>Technology</th>
<th>Know How</th>
<th>Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Move off insurance</td>
<td>&lt;$30K&gt;</td>
<td>1st yr—2 hrs/wk</td>
<td>Redesign books</td>
<td>40 hrs of CE</td>
<td>Front desk</td>
</tr>
<tr>
<td>Close office Saturday</td>
<td>&lt;$25K&gt;</td>
<td>40 hrs</td>
<td>[none]</td>
<td>Rescheduling</td>
<td>Front desk</td>
</tr>
<tr>
<td>Expand hygiene</td>
<td>$5K</td>
<td>1 hr / wk</td>
<td>Minor equip</td>
<td>Trg for staff</td>
<td>Decision making</td>
</tr>
</tbody>
</table>

etc.

etc.

Totals
After the columns have been completed for each plan, they should be summarized on a new sheet of paper. The total of all costs, time, etc. can represent a significant investment when considered together. Often times, more resources are needed to achieve our dreams than we have available. Proceeding with inadequate resources is dumb. It will lead to frustration, lying about results, and making excuses. Since it is human nature to overestimate the resources available, the best strategy is to rethink the plan to drop out some nice but not essential improvements and to spread out the timeline for achieving some of the more important ones.

The dentist whose budget is shown in Table 2 may rethink the strategy. The practitioner is getting a little time and freedom for a small outlay of expenses, but overall practice income will be down initially and the staff must be given substantially more authority.

Balanced Scorecard
The third major outcome of considering mission and vision statements, key success factors, core values, and performance indicators is the balanced scorecard. An honest plan for making a better organization must include both resources and some way for measuring whether progress is being achieved. Measuring success is a prospective activity: deciding what to measure after you have finished is cheating. The inflated sense of success that comes from post hoc evaluation is not as damaging as the affect this approach has on misdirecting the strategic energies of an organization. In the War Between the States, the Confederacy won most of the military battles. A balanced scorecard would have given a more realistic overview of the contest.

Choosing Indicators. Balancing investments in organizational improvements is as important as balancing one’s financial portfolio. This balance should extend across three dimensions. Key performance indicators should be identified for both what the organization is and what it can become—mission statement and vision statement.

Balance must also be achieved in various functional areas of the organization. In a dental practice, equal attention might be given to the front office, technical procedures, and patient interactions. Balance might also be accomplished by focusing on the dentist, the staff, and the patient. The division of attention used in Table 3 comes from the authors Robert Kaplan and David Norton who pioneered the balanced scorecard. They suggest four categories for attention: (a) financial stability, (b) customer focus, (c) process efficiency, and (d) growth and learning. These domains have the advantage of being applicable in almost all organizations. It is no accident that they are also key criteria in the Baldrige process.

Kaplan and Norton start with the bottom line. That's good marketing because most leaders are reluctant to consider other views of the organization until worries on this count have been settled. Dentistry has generally moved beyond most other aspects of American enterprise to achieve a better balance among indicators of performance. The typical corporate perspective gives abundant detailed attention to financial indicators in its annual reports, but may only gesture in the direction of customers, process, and growth through pictures and text, but seldom in numbers.

### Table 3. Example of a Balanced Scorecard for a Dental Practice
(Mission of family-oriented, small-town practice: vision is substantial growth in practice size).

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Target</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Financial Stability</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Gross income</td>
<td>$400,000</td>
<td>Vision, Lagging</td>
</tr>
<tr>
<td>2. Signed financial plans</td>
<td>98%</td>
<td>Mission, Leading</td>
</tr>
<tr>
<td>3. % income from new procedures</td>
<td>15%</td>
<td>Vision, Leading</td>
</tr>
<tr>
<td><strong>Customer Concerns</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Time to appointment</td>
<td>two weeks</td>
<td>Mission, Leading</td>
</tr>
<tr>
<td>5. Recall in eight months</td>
<td>80%</td>
<td>Mission, Lagging</td>
</tr>
<tr>
<td>6. New patient referrals per patient</td>
<td>20%</td>
<td>Vision, Leading</td>
</tr>
<tr>
<td>7. Accept full treatment plan</td>
<td>75%</td>
<td>Vision, Leading</td>
</tr>
<tr>
<td>8. Reduce referrals</td>
<td>&lt;20%</td>
<td>Vision, Leading</td>
</tr>
<tr>
<td><strong>Process Efficiency</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Redo rate</td>
<td>&lt; 2%</td>
<td>Mission, Lagging</td>
</tr>
<tr>
<td>10. Insurance returns</td>
<td>&lt; 3%</td>
<td>Mission, Lagging</td>
</tr>
<tr>
<td>11. Patients greeted by first name</td>
<td>95%</td>
<td>Mission, Leading</td>
</tr>
<tr>
<td>12. Patient wait time</td>
<td>80%</td>
<td>Vision, Leading</td>
</tr>
<tr>
<td></td>
<td>&lt;10 min.</td>
<td></td>
</tr>
<tr>
<td><strong>Learning and Growth</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Local hires, internal promotion</td>
<td>All</td>
<td>Mission, Leading</td>
</tr>
<tr>
<td>14. Increase staff responsibility</td>
<td>Newsletter</td>
<td>Mission, Leading</td>
</tr>
<tr>
<td>15. Broader range of treatments</td>
<td>80 hours CE</td>
<td>Vision, Leading</td>
</tr>
</tbody>
</table>

Leadership
The critical importance of customers is becoming more apparent. Determining what they need and satisfying those needs is becoming part of everyday business, where ten years ago it was the way for industry leaders to excel. Dentistry has been very responsive in this area and it continues to thrive by offering new services when the doom and gloom sayers were wringing their hands over the rapid decline in DMF first noticed in the 1970s. (Now, however, the profession is facing ethical issues that didn’t exist before. What should be said, for example, to a patient who wants the veneers, invisible braces, and whitening but refuses treatment for a rapidly declining periodontal condition?)

Process efficiency refers to the way work is done in the dental office. Are crowns delivered quickly, at the lowest cost possible, and with long expected service lives? Can patients of record and new patients get appointments in a timely fashion? Is the rate of errors in billing and insurance claims processing close to zero? These are easy levels of performance to measure, and a staff member can be assigned the task of reporting on them with a one-page report each month.

The balanced office should also include attention to growth and learning. Dentistry is a rapidly advancing profession. Some offices may wish to define themselves strategically as being on the growing edge of such changes. If so, they are obliged to measure something that supports this strategy. Most offices will choose to remain current. No other alternatives seems defensible, so some measures will be required in areas such as continuing education, introduction of new technology, participation in organized dentistry, and other activities designed to ensure the future as well as the present of the practice.

The third dimension on which balance should be achieved in the scorecard has to do with indicators of past success and indicators of future success. These are called lagging and leading indicators. On the news, one hears occasionally that levels of inventory in American business have risen (or fallen) and that the gross domestic product has risen (or fallen). News about inventories, orders for durable goods, and consumer confidence are normally followed several months later by news about gross domestic product or balance of trade. Leading indicators are for results that are associated with likely future changes: lagging indicators are for results of decisions typically made sometime in the past.

Lagging indicators are most common because they are the easiest to gather. Your accountant, for example, can tell you with great accuracy how you did last year. All of the dissatisfied customers who do not return or who come late give you lagging indicator information about customer service. The problem with lagging indicators is that they reflect old strategy and investment and resources that took place so long ago that you can’t do anything about them. Expenses for new technology, new patients starts, and percent of practice income from procedures that have been introduced during the past three years are examples of performance indicators that point the way towards the organization’s future.

The balanced scorecard is composed of performance indicators selected to represent the organization’s mission and vision. The indicators must be chosen in advance to ensure that the right data are gathered and that a balance is achieved. No more than twenty and possibly as few as twelve indicators should be chosen. It is just too much work to collect information on more indicators and it becomes impossible to manage them as their numbers multiplies. Also when there are many to choose among, it is human nature to focus on the most favorable and ignore others that are critical. By paying careful attention to the three dimensions proposed by Kaplan and Norton (mission and vision, domains of the practice, and leading and lagging indicators), it is possible to select a small but representative set of indicators for the scorecard.

The balanced scorecard has been used in industry for about ten years. It is seldom, however, seen as a collection of bragging rights. Companies do not publish the result of balanced scorecard, they use them as internal guides to managing the organization. Target levels of performance can be set for each performance indicator. This makes them powerful management tools.

Choosing Targets. It is not enough to measure performance levels in each of the areas of the balanced scorecard. What does it mean to learn that 11% of practice income is devoted to retiring debt? What does it mean that 7% of patients decline the offered treatment plan or that there are six new patients entering the practice each month? Numbers without comparisons are meaningless. Numbers that do not lead to action when necessary are a waste of time. Figure 1 shows how performance indicators must be tied to comparisons and actions.

Finding comparison data places your own performance in a meaningful context. By talking with colleagues, it is possible to form a general impression of how they way your office stacks up. Reading

**Figure 1. Schematic Representation of Landmarks for Using Performance Indicators to Improve Practice.**
broadly adds to this understanding, as does going to conventions. The Internet is now a useful resource in this area (although there is a lot of junk to wade through as well). The ADA is a wonder-

Where minimal standards can be identified, it is important to set personal goals some level above those minimums in order to provide a reasonable safety buffer.

Knowing what comparable practices are achieving for various performance indicators provides useful information. But it does not determine the goals for one’s practice. Each practice is unique and evolving.

ful resource that should be used more. Its Survey Center gathers and analyzes a wealth of information about practices that they are willing to share. Some dentists hire consultants primarily because they want to know what these consultants have found in other dental practices. When making a choice on which performance indicators to add to the balance scorecards, it is reasonable to favor those for which comparison data are readily available.

The three marks on the underside of the performance indicator line in Figure 1 represent landmarks that are important to the individual practice. The landmark in the center is the target or objective for performance in the particular office. The symbol “DS” is used conventionally to stand for “design specification”—the level of performance that is expected in the practice. Design specifications should be used for fine-tuning in resource allocation. Once the target performance level has been set, a useful check is to go back to the budgeting exercise described above and ask whether sufficient resources have been allocated to justify an expectation that the target level of performance will be achieved, given what is known about practices in general through the benchmarking process.

All performance indicators should have lower limits. This is the minimal acceptable level of performance. The abbreviation “TP” is conventionally used to designate “trigger point”—a level of performance that automatically initiates corrective action. Sometimes, but not always, there is an upper limit or level of performance that requires redesign of the process. When results are consistently high (above the upper limit), serious attention should be given to this performance indicator. Among the alternatives are reconsidering the process because it’s success is due to over- allocation of resources that should be directed else where, raising one’s standards because the learning curve has made it possible to achieve higher results with consistency, or accepting success gracefully and stopping measurement of this performance indicator in order to focuses on something else that matters more.

Without setting upper and lower limits on performance for the things a practice has said matter most to its survival and its future, the practice will drift. Putting too much weight on the performance indicators will cause the opposite problem—over- steering and hypersensitivity that will drive everyone to distraction. Achieving the right balance between indifference and overreaction requires focus on the correct landmarks. It is a subtle point, but it is necessary to distinguish between fixing a process and fixing the output of that process. As described in a previous leadership column (2001, Number 4), temporary crowns that fall off should be re- cemented and billing errors should be corrected—always. But the occurrence of a technical failure or a clerical error does not automatically mean that the process is defective. Only a trend of problems can identify a system that does not work (below the lower limit) or that works too well (above the upper limit). That is why in Figure 1, the area between the lower and upper limits is labeled the “zone of emotion.” Changes in performance indicators within this zone are causes for satisfaction or dissatisfaction, but not for reaction. It is only when performance indicators fall below the Trigger Point or above the upper limit that action is necessary—and then it is obligatory. Outcomes in these areas fall in the “zones of action.”

If this rule is observed consistently, performance indicators can become powerful management tools that drive an organization to achieve its objectives and preserve its mission while achieving its vision.
**Recommended Reading**


This is a cleanly written guide to selecting metrics, the measurement, reporting, and use of which will drive organizational improvement. Using the Baldrige categories as a structure, Brown makes useful suggestions about what to measure. He is a freelance consultant in this field. “The basic premises of this book are that it is important to develop measures that focus on the past, present, and future, and that measures need to consider the needs of your customers, stakeholders or owners, and your employees” (vii).


Michael Graham Brown is a consultant and speaker in the field of developing evaluation systems that help organizations achieve high performance. The balanced scorecard is a notion that each manager or management group should monitor a small number of indicators of organizational effectiveness. This book describes how the indicators are selected based on an organization’s mission and vision so that various functions at all levels in the organization are aligned and progress can be monitored. The concepts of a balanced scorecard are straightforward, but its implementation is difficult because measurement is not an exact science, some important outcomes are difficult to measure, and a large number of factors impact an organization’s effectiveness. “As we enter the twenty-first century, the new mantra for organizational performance seems to be balance. What we have learned in the last twenty years is that it is foolish to focus on any singular aspect of performance” (viii). “The real value of performance data is that it allows you to get slightly better at key aspects of performance that your competition” (ix). Some common mistakes include (a) tracking metrics that cannot be influenced or controlled, (b) gathering data that tells you what you already know, (c) gathering data for its own sake, (d) relying heavily on customer satisfaction surveys, (f) executives who are focusing on details, (f) measures are not linked to the strategic plan, (g) failing to define practical correlations between key metrics, (g) reporting data that is difficult to read and analyze, (f) using superstitious process metrics, (f) measures that drive the wrong performance.


How to plan without getting drowned in detail.


How to benefit from what the best have already learned.


How to distinguish between random deviations and deviations that reflect processes that are out of balance, and why only the latter should be corrected.


The authors have turned their well-known series of articles in the Harvard Business Review into a trade book. The emphasis has shifted slightly from advocating a representative sampling of measures in the four areas of financial outcomes, customer initiatives, process efficiency, and learning and growth (with both leading and lagging indicators) to making certain these measures reflect the organization’s strategic direction and that they are deployed so as to involve all employees in the process and align the organization’s allocation of resources. Kaplan is a professor of accounting and Norton is a CEO. Both authors have extensive consulting experience and the book is a report on about eight years of experience improving the Balanced Scorecard concept.

**Editor’s Note**

Summaries are available of the three readings preceded by an asterisk (*). Each is about four pages long and conveys both the tone and content of the book through extensive quotations. These summaries are designed for busy readers who want the essence of these references in fifteen minutes rather than five hours. Summaries are available from the ACD Executive Office in Gaithersburg. A donation to the ACDE Foundation of $15 is suggested for the set of summaries on keeping score; a donation of $50 would bring you summaries of all the 2002 leadership topics.