

# Journal *of the* American College *of* Dentists

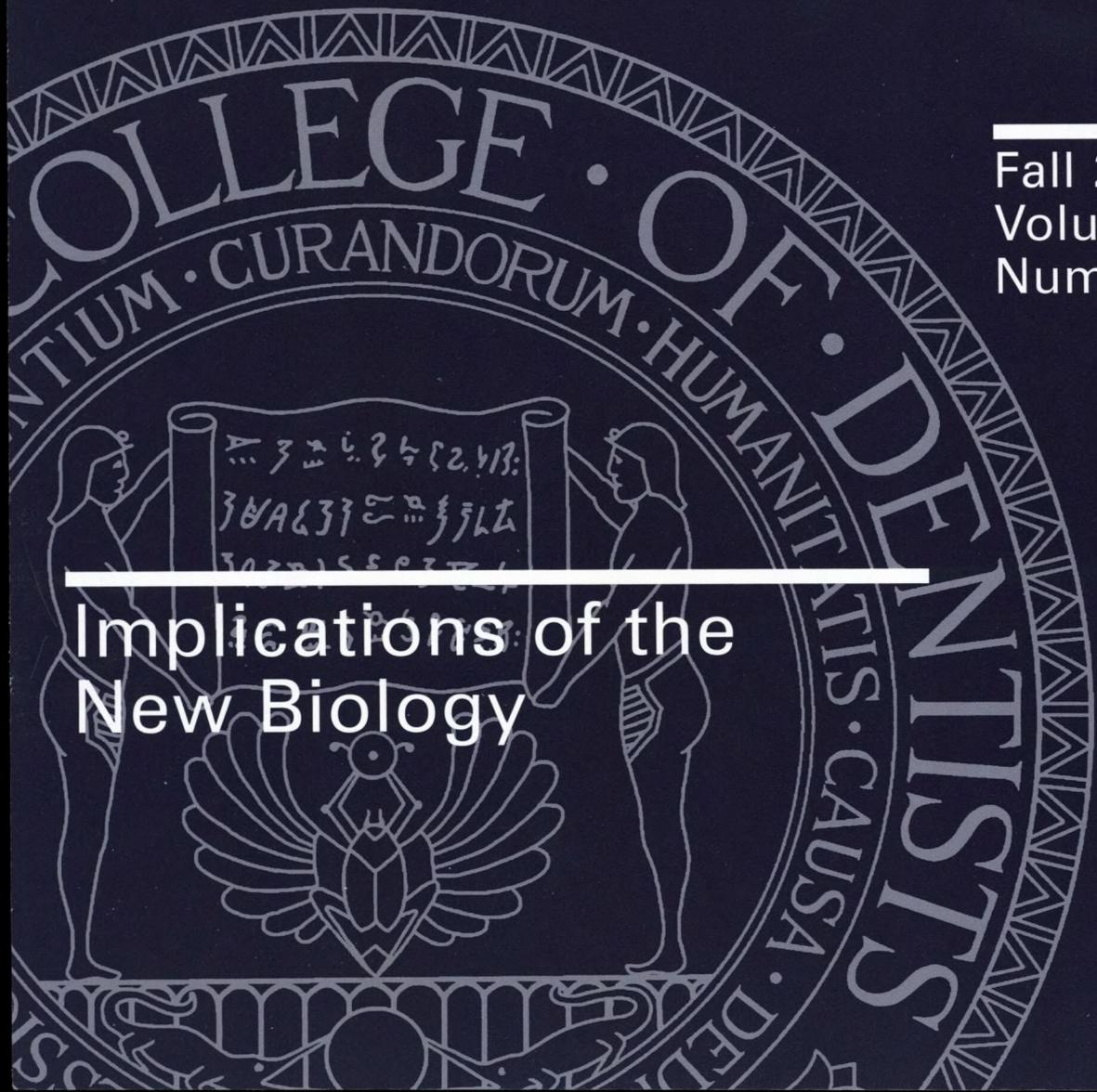
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Fall 2003  
Volume 70  
Number 4

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Implications of the  
New Biology

The seal of the American College of Dentists is a large, circular emblem. It features two figures, a man and a woman, standing on either side of a central scroll. The scroll contains text in a stylized, possibly ancient or symbolic script. Below the scroll is a large, detailed illustration of a butterfly. The outer ring of the seal contains the text "COLLEGE OF DENTISTS" at the top and "CURANDORUM HUMANITATIS CAUSA" at the bottom. The entire seal is rendered in a light, monochromatic color against the dark background of the cover.

# Journal of the American College of Dentists

## A Publication Presenting Ideas, Advancements, and Opinions in Dentistry

*The Journal of the American College of Dentists* (ISSN 0002-7979) is published quarterly by the American College of Dentists, Inc., 839J Quince Orchard Boulevard, Gaithersburg, MD 20878-1614. Periodicals postage paid at Gaithersburg, MD. Copyright 2003 by the American College of Dentists, Inc.

Postmaster: Send address changes to:  
Managing Editor  
*Journal of the American College of Dentists*  
839J Quince Orchard Boulevard  
Gaithersburg, MD 20878-1614.

The 2003 subscription rate for members of the American College of Dentists is \$30 included in the annual membership dues. The 2003 subscription rate for nonmembers in the U.S., Canada and Mexico is \$40. All other countries are \$60. Foreign optional air mail service is an additional \$10. Single copy orders: \$10.

All claims for undelivered/not received issues must be made within 90 (ninety) days. If claim is made after this time period, it will not be honored.

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For bibliographic references, the *Journal* is abbreviated *J Am Col Dent* and should be followed by the year, volume, number, and page. The reference for this issue is *J Am Coll Dent* 2003; 70(4):1-68.



Publication Member  
of the American Association  
of Dental Editors

## Mission

**T**HE 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

**T**HE AMERICAN COLLEGE OF DENTISTS, in order to promote the highest ideals, develop good human relations and understanding, and extend the benefits of good oral health to all, declares and adopts the following principles and objectives as ways and means for the attainment of these goals.

- A. To promote within the dental profession the highest ethical standards, stimulate interprofessional relationships, urge upon the professional person recognition of his/her responsibility to participate in the affairs of society as a citizen of the community;
- B. To take an active role in the support of dental education and research;
- C. To encourage qualified persons to enter the profession of dentistry;
- D. To encourage graduate education and improve continuing educational efforts by dentists and auxiliaries;
- E. To encourage the free exchange of ideas and experiences in the interest of the patient;
- F. To foster the extension and improvements of measures for the prevention and control of oral disorders; and
- G. To confer Fellowship in the College on individuals in recognition of meritorious achievement and their potential for contributions in dental science, art, education, literature, human relations, and other areas that contribute to human welfare, and to give encouragement to them to further the objectives of the College.

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# FROM THE EDITOR

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## *What Winners Reveal About Good Journalism*

There are four sets of awards in dental journalism. The oldest and most prestigious is the Gies Award for editorial writing. Begun in the 1930s by the American College of Dentists with funds originally raised to assist Dr. William J. Gies in his work as editor of the *Journal of Dental Research*, the award and several honorable mention recognitions are given for an editorial appearing in a publication that is a member of the American Association of Dental Editors (another group started by ACD). Another long-standing set of awards is sponsored by the International College of Dentists, who annually recognize about twelve organizations for graphic display, handling of a theme, and major improvement in overall appearance. An award in its second year is sponsored by the American Dental Association in honor of its recently retired editor, Dr. Larry Meskin. The Meskin award is given to a student dental publication.

Another new award is the American College of Dentists/American Association of Dental Editors Award for writing that promotes ethics, excellence, and professionalism. Like the Gies award, this prize is for content rather than layout. The ACD/AADE prize has been given three times. The first award was to Mr. Sidney Rocke, a lawyer, who wrote

in JADA about "The war on fraud and its effect on dentistry." In 2002, a freelance writer for the CDA Journal named Janyce Hamilton won for a discussion of the practice potential and ethics of genomic research. This year, the winners were Drs. Polly Nichols and Gerald Winslow, a dentist and an ethicist. They wrote about conflicts of interest in endorsing products.

believe it is also the only award where all contestants receive written feedback on their entries.

What do these excellent writers choose as their topics? We know there is concern over Internet deception, oral care for older Americans, franchise dental offices, volunteerism, the plight of dental education, and access to care. There is also a dear friend who contributed so

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*Those who have something special to say to the profession are writing about the people and the issues that surround the daily decisions and dynamics of individual practices. They are focused on the shifting context that gives practice its meaning.*

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The Prize for Excellence, Ethics, and Professionalism in Dentistry is administered by the ACD and the AADE together. Judging is conducted by a panel of editorial board members and officers from both organizations. For the three years of judging, the calibration among judges has been over .900 (Cronbach alpha). In peer review situations in medicine, consistency is generally around .300. To my knowledge, this is the only prize in dentistry where the consistency of the judges is reported. I

much to the profession, a silly incident proving that bureaucracy is still alive and well, concern over waterlines, and an abundance of professional wisdom accumulated over many years of practice. Nothing about the setting time of polymers or how to make a buck. Those who have something special to say to the profession are writing about the people and the issues that surround the daily decisions and dynamics of individual practices. They are focused on the shifting context that gives practice its meaning.

Now for a few strong lessons from the winners. First, it is clear that the best papers exhibit substance and depth. So far, no editorial has won; none has been in the top quarter. The top scores have gone to papers with references that quoted extensively from a range of authorities. They have presented several sides of the issue. They have never told the reader how to think or act. The judges are nearly unanimous that the best of dental journalism explores the full complexity of emerging issues, emphasizing fact and analysis.

It may be coincidence, but three of the four winners are not dentists. Perhaps a writer can be too close to his or her field; maybe dentists write from deep personal perspective that does not easily generalize across the profession. It is certainly not the case that dentists are

bylaws that require their editors to be dentists.

Finally, there is the matter of length. Editors hear often enough from readers and reviewers that manuscripts need to be shortened. A study was commissioned by the Canadian Dental Association and was published in the

papers. In fact, the calculated correlation between word count and judges' scores is .601. Longer papers are much more likely to be seen as excellent. I like to imagine that the best writing tackles the most difficult problems in a balanced and thorough way. That requires a good supply of words.

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*The winners of the Prize for Excellence, Ethics, and Professionalism in Dentistry have always been long papers.*

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March issue of the *Journal of Dental Education* documenting Canadian dentists' desire for the "facts without a lot of fuss and analysis." The Gies Editorial Award has a word limit. Anything that

A review of the papers in the ACD/AADE competition suggests that judges are quite consistent in favoring papers that are long enough to give detailed, balanced, and objectively detached analysis of emerging issues. The facts need to be presented and understood—then the readers can make up their own minds. There is a place in dental journalism for cries of outrage and simple solutions grounded in personal experience. There is also a place for facts and deep thinking. I believe data and judgment together beat either alone any day.

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*There is a place in dental journalism for cries of outrage and simple solutions grounded in personal experience. There is also a place for facts and deep thinking.*

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shallow thinkers or poor writers. Dentists are the best writers about clinical research and practice. But it might be difficult for dentists to step outside of practice to get a clear view of emerging trends. This is a matter that deserves some consideration since many dental organizations, including the ADA, have

is exhortatory opinion and shorter than one thousand words is an editorial. Thought pieces longer than that are something else (sermons?).

It will come as a surprise then to find that the winners of the Prize for Excellence, Ethics, and Professionalism in Dentistry have always been long

Some readers may find it discomforting to report correlation coefficients about word counts and indexes of the consistency of judges. After all, this is supposed to be an editorial. Don't worry, my computer is set to tell me to stop at 999 words.



David W. Chambers, EdM, MBA, PhD, FACD  
Editor

# Today I Offer a Challenge to You

ACD President-elect's Address  
October 23, 2003  
San Francisco, California

John I. Haynes, DDS, FACD

Officers and members of the Board of Regents, current Fellows, spouses, friends, and guests: I am pleased that you could all be with us on this special day. Candidates for fellowship, I congratulate and welcome you to the American College of Dentists and, in addition, I wish to recognize those who nominated you for fulfilling this important responsibility as Fellows.

them to become involved in the work of your section. Many of the sections are active in a variety of ways. It is the duty of the section officers and each of the members to create activities that promote participation. I offer a challenge to you as well. If your section is an active one, make every effort to help take it to the next level. If your section is one that would benefit by becoming more active, help to provide that encouragement.

## Our History

Since our founding in 1920, we have continued our efforts to support the development of dentistry as a profession. The College has always been an advocate in support of dental education and the necessity for continuing education. The College supports mentoring and role modeling done by both the faculty in our schools and those in private practice. The College acknowledges the importance of support for dental research, promotion of journalism, and the history of the profession. This year a CD on the history of dentistry was developed by our Executive Director, Dr. Steve Ralls. We intend to provide this to incoming students.

Another challenge has been to increase participation in the expansion of ethics programs in our schools. The school administration and course directors were contacted, and Fellows came forward to assist in this important endeavor. This can be a wonderful section project. We need to expand and

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*You can be a participant or you can lead. It is our hope that you will choose to participate and lead. Fellowship is based upon leadership.*

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To be considered for fellowship is a significant accomplishment. You must be nominated, and your nomination seconded by active Fellows, for consideration by the credentials committee. There are a variety of ways you may choose to acknowledge attainment of fellowship. Today I offer a challenge to you. You can be a participant or you can lead. It is our hope that you will choose to participate and lead. Fellowship is based upon leadership.

You have already demonstrated this quality. Your nominators recognized that you possessed outstanding skills as leaders making you deserving of nomination. Now, you, the nominators, will need to join with these new Fellows to encourage

An important role you will play is to nominate deserving dentists to fellowship. It has never been the intent of the College to hold membership drives. However, we do recognize that there are many individuals worthy of fellowship who have not been nominated. We ask that you become involved in this important role. We need Fellows to help us preserve dentistry as the wonderful profession it is—not letting it become, in essence, just another business or trade. We realize that your participation will be required to continue the pursuit of our primary mission of promoting excellence, ethics, and professionalism in dentistry and to support our strategic plan.



Dr. Haynes is Professor of Pediatric Dentistry at the School of Dentistry, University of Missouri—Kansas City.

support the white coat ceremonies conducted by many of the schools. These are conducted prior to students entering the clinic to begin providing patient care. At my school, I see increased involvement of those in the practice community in mentoring projects. The students are shown the importance of becoming involved in their profession. When visiting the sections, I am impressed with the recognition being given to students for both scholarship and leadership. It has been my privilege to meet these students. I have little doubt from these experiences that the future of the profession is bright. This is certainly a challenge that should engage new and experienced Fellows alike.

The officers and Board of Regents are committed to serving the organization. We have a wonderful staff, led by Dr. Stephen Ralls. The staff includes his Executive Assistant, Karen Matthiesen, our Controller, Paul Dobson, and Rachel Reges, Alex Zouras-Wieneke, and Angela Wong. Get to know these people. They will help you meet the challenge I am giving you today of continuing to promote excellence, ethics, and professionalism.

I now wish to recognize some of the people who have made a difference in my life. This past March marked my forty-first year as a member of the faculty at the University of Missouri-Kansas City School of Dentistry. I was born and

I have been privileged to work: Drs. Marvin E. Revzin, Russell W. Sumnicht, and Michael J. Reed. My faculty and staff colleagues, especially those in the Department of Pediatric Dentistry, who make coming to school each day a joy. The officers and members of the alumni association; the alumni association staff; the officers, membership, and staff of Xi Psi Phi fraternity; and the many students who have given so much joy to me. The wonderful, dedicated staff of the American College of Dentists, and those members of my section, the Kansas City-Midwest.

And finally, my wife of forty-two years, Judy, who has always been at my side and so supportive. Our children, John and Karen, who have made us such proud parents. My heartfelt thanks to all of you.

You will notice that I have had a lot of people to thank. Happy indeed is the man who has received so much for which to be grateful. If you will accept the challenge I offer you today, you too will have your list. And, perhaps even more importantly, you will be on the list of those who made a difference to future generations in this profession.

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*It has been my privilege to meet these students.  
I have little doubt from these experiences that the  
future of the profession is bright.*

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### Financing

The officers, the Board of Regents, and the central administration are diligent in their efforts to demonstrate sound fiscal management and oversight. This is accomplished through the American College of Dentists Foundation, which needs your support. The Foundation oversees the Gies Fellow Program, many named funds, and our annual request for support in the dues statement. The College continues to look for sources of non-dues revenue. Some examples are cruise programs, the silent auction held at the annual meeting, and the gallery.

### Some Special People

I wish to acknowledge the outstanding job done by our president, Dr. Roger Triftshauser. His wonderful enthusiasm, love, and dedication to the College and to the profession have been evident to me since our first meeting. Thank you Roger! Dr. Kenneth Follmar continued to do a remarkable job in his role as President of the Foundation this past year. He is a fine, dedicated individual.

reared in Kansas City, and was a patient at the school as a child. For me, that is where it all started. I was impressed with the student doctors and I enjoyed being around them, and continue to do so. After graduation, I practiced in Kansas City for a few years prior to joining the faculty.

I stand before you today, owing so much to so many. My parents, my brothers, and my sister, who sacrificed so much and provided me with encouragement and financial support necessary to complete my education. My many teachers, Dr. Roy J. Rinehart, then dean of the school of dentistry, who gave me the opportunity by granting me admission. My mentors, Drs. Arthur E. Iwersen, and Jack E. Wells. Dr. Iwersen was my teacher, mentor, colleague, and most importantly, my friend. I had the privilege of working with him over thirty years. He was always encouraging and supportive.

Dr. Hamilton B. G. Robinson, who was dean when I joined the faculty, and the deans that followed him, with whom

### Your Special Day

Candidates for fellowship, this is your day!

The central office staff works to make this day very special for you. The Convocation Ceremony will be a highlight, followed by the dinner this evening. It is my sincere hope that I may have the opportunity to greet and welcome each of you to fellowship. Please join us by being active participants. When we bring together all of the elements that have been discussed, we will have successfully attained our goal. Participation is the key to success.

In closing, it is my hope that God will continue to bless you and those you love, the patients in your care, our wonderful profession, our splendid organization, the United States of America, and those who defend her.

# 2003 Fellowship Class

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*The Fellows of the American College of Dentists are the leaders in dentistry and in their communities. They represent the creative force of today and the promise of tomorrow. We proudly welcome the 2003 class of Fellows ...*

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|--|--|--|
| Paul V. Abbott<br><i>Nedlands, WA, Australia</i> | Jackie L. Banahan<br><i>Lexington, KY</i>        | Joseph Wayne Browder<br><i>Colonial Heights, VA</i>    |
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*Park Ridge, IL*
- Larry B. Knutson  
*Spokane, WA*
- Daniel B. Krantz  
*Somerset, NJ*
- Brian K.S. Kucey  
*Edmonton, Alberta*
- Paul M. Lambert  
*Dayton, OH*
- James R. Lance  
*Richmond, VA*
- Alfred LaPorta  
*Armonk, NY*
- Casimir Leknius  
*San Francisco, CA*
- Angelique Leung  
*Vancouver, British Columbia*
- Alan S. Levi  
*St. Louis, MO*
- Jong Shiaw Lim  
*Elmburst, NY*
- Michael Joseph Link  
*Newport News, VA*
- Peter M. Lobb  
*Victoria, British Columbia*
- Jack L. Long  
*Dallas, TX*
- John Preston Longmire III  
*Tampa, FL*
- Geoffrey J. Longson  
*London, England*
- Frederick Bland Lopp  
*Greensboro, NC*
- Lonnie Ray Lovingier  
*Mission Viejo, CA*
- Eric Luks  
*Toronto, Ontario*
- James P. Lund  
*Montreal, Quebec*
- Garry W. Lunn  
*Vancouver, British Columbia*
- Barry D. Lyon  
*Glen Burnie, MD*
- R. Lamont MacNeil  
*Farmington, CT*
- Kerry Maguire  
*Boston, MA*
- Richard A. Mahevich  
*North Brunswick, NJ*
- Scott Roger Makins  
*Houston, TX*
- Paul John Malone  
*Batavia, NY*
- Amon A. Martin, Jr.  
*Seneca, SC*
- Timothy R. Martin  
*Kingsport, TN*
- Justin J. Martin, Jr.  
*Canadaigua, NY*
- Craig A. Mason  
*Kailua, HI*
- Ernest A. Mastroianni  
*Kent, OH*
- George E. Mayo III  
*Goldsboro, NC*
- Holly Anne McAllister  
*Zanesville, OH*
- Paul Thomas McCord  
*Cleveland, TN*
- Michael Grady McCorkle  
*Orlando, FL*
- Gary M. McCown  
*Knoxville, TN*
- George A. McCully  
*Eugene, OR*
- Barry Roland McGuire  
*Farmington, CT*
- Thomas Warren McKinney  
*Dallas, TX*
- George C. McLaughlin  
*New Brunswick, NJ*

- Bruce Carlton McLeod  
*Hendersonville, TN*
- David Eugene McNeely, Jr.  
*Elizabethton, TN*
- Fred E. Meece  
*Prestonsburg, KY*
- Deborah L. Meegan  
*Florissant, MO*
- Jessica A. Meesce  
*Hastings, NE*
- Raymond John Melrose  
*Los Angeles, CA*
- Stephen B. Milam  
*San Antonio, TX*
- Norman Martin Miller  
*Montreal, Quebec*
- Alan Boyd Moore  
*Austin, TX*
- Cindy Casavant Moore  
*Panama City, FL*
- Frederick T. Moore  
*Boston, MA*
- Grahame J. Moore  
*Rose Park, South Australia*
- William B. Moorkamp III  
*Rolla, MO*
- George B. Morledge III  
*Little Rock, AR*
- Ronald F. Moser  
*Bowie, MD*
- Sheldon Nadler  
*New York, NY*
- John P. Nei  
*Long Prairie, MN*
- George Chung-Shun Ng  
*Burnaby, British Columbia*
- David Frank Nichols  
*Tyler, TX*
- Kirk W. Noraian  
*Bloomington, IL*
- Richard T. O'Day  
*Arvada, CO*
- Daniel John O'Neill  
*Butte, MT*
- Lane M. Ochi  
*Beverly Hills, CA*
- Joseph Oliver, Jr.  
*Torrance, CA*
- Joe Scott Olsen  
*Sioux Falls, SD*
- Larry William Osborne  
*Decatur, IL*
- Wayne Palestini  
*Birmingham, AL*
- Fontinos S. Panagakos  
*Newark, NJ*
- Renaldo G. Parisi  
*Piedmont, CA*
- M. Alec Parker  
*Fletcher, NC*
- Robert Emerson Parker III  
*Rochester, NY*
- Glenn S. Parry  
*Green River, WY*
- Pankaj Patel  
*Nairobi, Kenya*
- Garnet L. Patterson  
*Mokena, IL*
- Gregory J. Peppes  
*Leawood, KS*
- Kent Hereford Percy  
*Marietta, GA*
- Anthony L. Perez  
*Ventura, CA*
- Lorin D. Peterson  
*Cle Elum, WA*
- Suzanne R. Philip  
*Vancouver, British Columbia*
- Jon Eugene Piche  
*Yorktown, VA*
- Paul K. Piontkowski  
*Oxon Hill, MD*
- Peter J. Polverini  
*Ann Arbor, MI*
- Bradford J. Porter  
*Haddonfield, NJ*
- Steven P. Quinn  
*Springfield, MO*
- Tofigh Raayai  
*Everett, MA*
- James Carlton Ragain, Jr.  
*Great Lakes, IL*
- Hedley Rakusin  
*Dallas, TX*
- Linda Ellis Records  
*Columbus, OH*
- John V. Reitz  
*Reading, PA*
- John C. Remien II  
*Missoula, MT*
- Mark A. Reynolds  
*Baltimore, MD*
- Mark S. Ritz  
*Homerville, GA*
- Donald G. Robertson  
*Sidney, British Columbia*
- Stephen Wayne Robertson  
*Bowling Green, KY*
- Bette Robin  
*Covina, CA*
- Peter Jay Robinson  
*Farmington, CT*
- Robert Stephen Roda  
*Scottsdale, AZ*
- William C. Roddy  
*Fort Worth, TX*
- Stephen C. Roehm  
*Peoria, IL*
- Clyde L. Roggenkamp  
*Loma Linda, CA*
- Morton B. Rosenberg  
*Boston, MA*
- Arthur Louis Ross  
*Vancouver, British Columbia*
- Jan B. Rozen  
*Boston, MA*
- Richard Alan Rubinstein  
*Farmington Hills, MI*
- Ramesh Kumar Sabhlok  
*Dubai, United Arab Emirates*
- Salam Sakkal  
*Montreal, Quebec*
- Edward Mark Salamoff  
*Brookline, MA*
- Gerald S. Samson  
*Marietta, GA*
- Michael L. Santucci  
*Belvidere, IL*

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- Harvey S. Satz  
*Ft. Meyers, FL*
- Donald E. Scharfenberger, Sr.  
*Louisville, KY*
- Titus K.L. Schleyer  
*Pittsburgh, PA*
- Michael John Schneider  
*Manhattan Beach, CA*
- Scott A. Schoen  
*Little Rock, AR*
- James W. Schwengel  
*Cedarburg, WI*
- Barbara Sheller  
*Seattle, WA*
- Preston G. Shelton  
*Baltimore, MD*
- Edwin F. Shryock  
*Loma Linda, CA*
- Robyn S. Silberstein  
*Highland Park, IL*
- Charles L. Silvius III  
*Revere, MA*
- William J. Simpson  
*Morrison, IL*
- Richard E. Sipes  
*Vancouver, WA*
- Cecile E. Skinner  
*Washington, DC*
- Edwin Slade, Jr.  
*Doylestown, PA*
- Gerry R. Solomon  
*Toronto, Ontario*
- James L. Soltys  
*Victor, NY*
- Dale Anthony Sorenson  
*Newburgh, IN*
- Oladimeji F. Sorunke  
*Sacramento, CA*
- Donna Bryan Spears  
*Butner, NC*
- William Henry Stalker  
*San Antonio, TX*
- Ronald Stanich  
*Massillon, OH*
- Jeffrey J. Stasch  
*Garden City, KS*
- James C. Steiner  
*Seattle, WA*
- Robert B. Stevenson III  
*Columbus, OH*
- Thomas H. Stewart  
*Bakersfield, CA*
- Angela Mary Stout  
*Erdenheim, PA*
- Stephen Robert Stricklin  
*Alabaster, AL*
- Jon O. Strom  
*West Vancouver, British Columbia*
- James Kenneth Sutherland  
*Saskatoon, Saskatchewan*
- Maureen Louise Swift  
*Bellevue, WA*
- Ernst Martin Taeger  
*Florissant, MO*
- Robert H. Talley  
*Las Vegas, NV*
- Daniel Tanguay  
*St. Jean su Richelie, Quebec*
- Ariane Renee Terlet  
*Berkeley, CA*
- J. Mark Thomas  
*Seymour, IN*
- Thomas Peter Torrisi  
*Methuen, MA*
- Randolph Thomas Travis  
*Madisonville, KY*
- Edmond L. Truelove  
*Seattle, WA*
- Fred S. Tsutsui  
*Torrance, CA*
- Alexandra Ukmar  
*Willoughby, OH*
- Ronald Leslie Ulinder  
*Abbotsford, British Columbia*
- John A. Valenza  
*Houston, TX*
- James H. Van Sicklin, Jr.  
*Stockton, CA*
- Smorntree Viteporn  
*Bangkok, Thailand*
- Gus C. Vlahos  
*Dublin, VA*
- Seymour Wachtenheim  
*Niles, IL*
- Michael J.C. Wake  
*Birmingham, United Kingdom*
- Craig W. Walker  
*Fort Oglethorpe, GA*
- Joanne N. Walton  
*Vancouver, British Columbia*
- Hom-Lay Wang  
*Ann Arbor, MI*
- Rueben C. Warren  
*Atlanta, GA*
- Kenneth J. Weinand  
*Independence, MO*
- Kimberly J. Westermann  
*Louisville, KY*
- Connie L. White  
*Kansas City, MO*
- Sidney Whitman  
*Hamilton Square, NJ*
- John Llewellyn Williams  
*West Sussex, United Kingdom*
- Edward McCray Wise  
*Beaufort, SC*
- Carol M. Wolff  
*Atlanta, GA*
- Maurice K.W. Wong  
*Vancouver, British Columbia*
- Alfred Jeffrey Wood  
*San Francisco, CA*
- James D. Wood  
*Cloverdale, CA*
- Dennis Duane Woofter  
*Washington, DC*
- George Marcus Yarbrough  
*Albuquerque, NM*
- Martin H. Zase  
*Colchester, CT*
- George Randall Zehak  
*Berwyn, IL*
- Anthony Joseph Ziebert  
*Milwaukee, WI*
- Walter Marshall Zierman  
*Santa Fe, NM*
- Joseph A. Zingale  
*Moraga, CA*

# Profiles in Professionalism: 2003 ACD Awardees

## William John Gies Award

The William John Gies Award was established by the American College of Dentists in 1939 to recognize Fellows for outstanding service to dentistry and its allied fields. This award embodies the highest levels of professionalism, and it is the highest honor the College confers on its members.



The highest honor the College can bestow upon a Fellow is the William John Gies Award. This award recognizes Fellows who have made exceptional contributions to advancing the profession and society. This year's recipient is **Dr. Lawrence H. Meskin**.

Dr. Meskin, a native of Detroit Michigan, received his dental degree in 1961 at the University of Detroit. Graduation was followed by private practice and then a move to the University of Minnesota where he was awarded three additional degrees, a Master of Science in Dentistry, a Master of Public Health, and a Ph.D. in Epidemiology. Immediately following the completion of these degrees, he became a full-time faculty member at the University of Minnesota. Concurrently he was awarded the prestigious Hill Research Professorship in Dental Health Services, and within a short period, the chairmanship of a new department called Preventive Dentistry.

In 1981 Dr. Meskin assumed the position of Dean of the University of Colorado School of Dentistry, serving in that position until 1987. Other academic positions followed including the Vice President for Academic Affairs and Research, Dean of the System-Wide Graduate School of the University of Colorado Health Sciences Center. He recently stepped down after eleven years as editor of the *Journal of the American Dental Association*. Dr. Meskin serves on the editorial boards of a number of journals, including the *Journal of the American College of Dentists*.

Dr. Meskin has also been active in the field of international dental health, serving for over two decades as a consultant to the Pan American Health Organization. He was instrumental in developing programs that use auxiliary personnel to deliver dental services, thus providing better services to the underserved.

A prolific author, Dr. Meskin has over one hundred publications in the dental and medical literature. He holds mem-

berships in various professional organizations and has served as an officer or board member for a number of them.

Dr. Meskin is the recipient of numerous honors and awards, including the coveted Thomas Jefferson Award from the University of Colorado, the Dr. Irving E. Gruber Award for Excellence in the Advancement of Dental Education from the Greater New York Dental Meeting, and the Distinguished Service Award from the Colorado State Dental Association. He was also named as one of dentistry's twenty-five "top" visionaries by the American Student Dental Association.

Presently, Dr. Meskin directs the continuing dental education program at the University of Colorado's School of Dentistry.

Dr. Meskin's leadership and achievements have had a significant and positive impact on dentistry, dental education, dental journalism, public health, his community, and his country.

## Honorary Fellowship

The ACD confers Honorary Fellowship upon persons who are not members of the dental profession, but have made outstanding contributions to the advancement of the profession and its service to the public. These contributions may be in education, research, administration, public service, public health, medicine, and many other areas.



Honorary Fellowship is awarded to individuals who do not hold a dental degree, but have significantly advanced the profession of oral health and have shown exceptional leadership in areas such as education, research, public health, administration, public service, or related fields of health care. This is the highest honor the College bestows on non-dentists. This year's recipient is **Mr. Robert A. Rechner**.

After completing his undergraduate degree in physics at Catholic University of America and completing two years as a high school teacher, Mr. Rechner secured a position as Program Specialist for the Bureau of Dental Health Education with the American Dental Association. During his years with the ADA, in addition to handling numerous and demanding responsibilities, Mr. Rechner acquired a Masters in Public Health degree from the University of Illinois. He remained

## 2003 ACD Annual Meeting

with the ADA until 1978 when he accepted a position with the Illinois State Dental Society as Assistant Executive Director and was promoted to Executive Director in 1979—a position he continues to hold.

Under his direction, the Illinois State Dental Society has made great strides in modernizing and advancing the organization's structure and functional capacity. Mr. Rechner has managed to significantly increase the myriad of benefits to member dentists and the public they serve. Two timely and critical changes that he implemented include the departmentalization of important and distinct aspects of the society's duties and creation of full-time directorship positions for newly formed departments, such as Director of Legislative and Government Relations and Director of Communication, Public Relations, and Publicity.

Mr. Rechner has served on various special committees of the ADA, including chair of several committees. He was involved with the committee to select the recipient of The Hillenbrand Fellowship from 1986 to 1991. He also served on the 2000 ADA Screening Committee to select a new executive director for the ADA.

He is an active member of the American Society of Association Executives and the Illinois Society of Association Executives, serving the latter as president in 1989. Mr. Rechner is the recipient of numerous honors and awards. He received the Distinguished Member Award from the Illinois Society of Association Executives in 1995. In 2002 he was named an honorary member of the American Dental Association. Mr. Rechner is also an honorary member of the Illinois State Dental Society, the Illinois Academy of General Dentistry, the Illinois Society of Oral and Maxillofacial Surgeons, and the G.V. Black Dental Society.

Mr. Rechner is widely known and respected for his honesty, integrity, common sense, and solid work ethic. He is passionately dedicated to his faith, family, profession, and community.

### Award of Merit

The supporting services of dentistry are vital to the profession, providing key elements that enhance the effectiveness of dental care delivery and the growth of the profession. The ACD's Award of Merit was established by the Board of Regents in 1959 to recognize unusual contributions in dentistry and its service to humanity by persons who are not Fellows of the College.



The Award of Merit recognizes outstanding efforts of non-dentists in roles that support the dental profession and enhance the profession's mission and service to society. This year's recipient is **Ms. Elza Harrison**.

Ms. Harrison has been a professional association manager for twenty-seven

years, working first with the Maryland State Medical Association and for the past fifteen years as Executive Director of the Maryland State Dental Association. Ms. Harrison represents the dental association in the state capitol, Annapolis. She has been an advocate for the underserved population in Maryland and was part of a successful team effort to increase the state budget for dental Medicaid. Ms. Harrison was instrumental in restoring the position of State Director of Oral Health after the position had been abolished.

As executive director of the dental association, Ms. Harrison initiated efforts to create the MSDA Charitable & Educational Foundation and the for-profit Dental Association Company. She initiated the creation of an electronic learning network, the Center of Oral Health Studies, for which she serves as CEO. Ms. Harrison is a founding benefactor and member of the Board of Visitors of the Dr. Samuel D. Harris National Museum of Dentistry. In her professional capacity, she has served as a mentor to oral health professionals and to her colleagues in the association management field. A Certified Association Executive, she is a past president of the Maryland Society of Association Executives.

Ms. Harrison is married to Michael Dunning and is the mother of Mark and Leslie Davis. She also serves as the chalice at the Church of the Holy Comforter in Lutherville, Maryland, and is currently enrolled in a four-year Education for Ministry program through her church.

### Service Award

This award is presented to recognize outstanding efforts of a Fellow of the American College of Dentists for exceptional and distinguished service of the College or to humanity through his or her professional service.



The Service Award recognizes exceptional support of the College, the profession, oral health, or community service. This year's recipient is **Dr. Burton L. Edelstein**.

Dr. Edelstein is a native of Rochester, New York. He graduated cum laude in 1972 from the State University of New York at Buffalo, School of Dentistry.

Following dental school he completed postgraduate specialty training in pediatric dentistry and a Master of Public Health degree from Harvard School of Public Health in 1977. He was certified by the American Board of Pediatric Dentistry in 1984. Dr. Edelstein has had a number of academic appointments including at Harvard School of Dental Medicine, the University of Connecticut, Case Western Reserve University, the University of New Haven, Georgetown University, the University of Iowa, and Columbia University. His resumé is replete with significant committee assignments on both a national and international level. He is the recipient of numer-

ous honors and awards and he has published extensively in the medical and dental scientific literature.

From 1996 to 1997 Dr. Edelstein served as a Robert Wood Johnson Health Policy Fellow, an Institute of Medicine assignment in the office of Senate Minority Leader Tom Daschle.

Dr. Edelstein's recent accomplishments include service as Chair of the U.S. Surgeon General's Workshop on Children and Oral Health and Chair, Planning Committee, Department of Health and Human Services, for the Secretary's Initiative on Oral Health. He was instrumental in organizing the effort and later the design and final product of the U.S.

Surgeon General's report on Oral Health. This document may well be the most significant single policy document ever produced for the dental profession.

Dr. Edelstein remains involved in the implementation of the Surgeon General's Report. He has led many states to understand the problems associated with access to care. His service as a dental consultant in many state oral health summits and his input into the National Association Policy Academies held around the country further demonstrate his resolve and commitment to addressing the inequities in access to oral health care.

# Dental Implications of the Human Genome Project

Janyce Hamilton

## Abstract

The Human Genome Project is uncovering exciting potential innovative understandings of oral disease and approaches to their testing, treatment, and management. The project is ethically neutral, but uses of its discoveries may not be. DNA records on computer chips, gene-based testing for disposition to diseases such as periodontics, and on-line health histories and databanks raise issues about privacy and even questions about whether such information should be known. Patient safety and changes in practice, dental education, and the relationship between dentistry and medicine are also related emerging issues.

**T**he Human Genome Project, now in its second decade of mapping discoveries, has brought dentistry gifts and curses. With researchers identifying about 300 known dental genes thus far and about 1,000 diseases and disorders with major orodental complications, comes the gift of knowledge. The curses soon follow, however, as dentists realize there is no treatment yet for almost all of

the problematic genes. To match the sometimes ominous results of sophisticated genetic screening tests, all dentists have are standard therapies: a scaler, a chip soaked with medicine, a graft.

It is a humbling realization.

Meanwhile, a news story on a study released by the Pew Internet and American Life Project at the end of 2000 found that "more Americans surfing the Internet look for medical information than for sports scores, stock quotes, or online shopping bargains."

In fact, 55% of 12,000 people surveyed went online for health information once per month. Dentists, often so bogged down in paperwork they have no time to search the Internet, may be shocked to find that their patients are sometimes better informed on the latest dental discoveries than they are.

The global scientific and health care community's wonderment continues as genetic discoveries affecting health make the news headlines each week. What the new cloning capabilities mean to medicine and dentistry is that the Human Genome Project is advancing science so rapidly that the production of new biochemical substances, tissues, and entire organs will be taken to new heights.

Xenograft tissue from animals? No problem.

Exograft tissue from a patient's own body, grown in a dish and reimplanted? No problem.

Disease prevention and delay, diagnosis, and treatment are advancing daily with mapping sequences being added to one of several public gene banks twenty-four hours a day by genome project international researchers. Investigators continuously tap the gene banks to hunt for genes that will advance their research or lead to a worthy patent.

As genetic discoveries affecting dentistry continue to emerge in the next few years, they will no doubt radically alter some of the basic concepts of disease and its management as taught in dental schools.



Ms. Hamilton is a Chicago-based freelance writer. This article won the 2002 ACD/AADE Journalism Prize for Ethics, Professionalism, and Excellence. It is reprinted by permission of the *California Dental Association Journal* where it first appeared.

This article contains interviews with top government, academic, and industry experts on dental genetics to profile what is known about the science, legal, ethical, insurance, and clinical aspects of genetics in dentistry. Dental school and continuing education, privacy, and future therapeutic issues are addressed with an emphasis on how patients' genetics are just now beginning to affect the dental practice.

### The DNA Panel

If one could peer into a crystal ball, the future dental practice would look quite the same. But some of the tests administered by dentists, and eventually the treatments given, would be markedly different.

Arthur Curley, JD, a San Francisco attorney and an assistant professor at the University of the Pacific School of Dentistry, specializing in medical, health, and dental law, believes that dentists will soon offer blood tests to assess if a disease status is under control. "Instant blood tests for blood sugar levels in diabetics, dilantin levels in epileptics, etc., will become the standard of care; and failure to at least recommend such tests will be malpractice." Then, as DNA testing becomes cheap and easy, Curley said, dentists may start to offer them to take potential-disease inventories. Key among the new tests will be an assay panel that uses cheek swabs, saliva, or crevicular fluid to screen patients for all known genetic dental disease susceptibilities.

Dentists may eventually offer tests for all known medical disease susceptibilities.

Affymetrix, in Santa Clara, California, is one of the better-known biotech companies that develops and commercializes systems that enable researchers to create, acquire, analyze, and manage complex genetic information. Affymetrix' DNA array technology identifies thousands of genes simultaneously using a DNA chip. Its technology is designed to capture the unique gene expression patterns and polymorphic variants of a person's genome (gene map).

The chip is a DNA affinity test. In simple terms, DNA sequences are combined with a computer chip. The subject's DNA sample is bathed over the chip. The subject's complementary DNA binds to the chip, indicating how similar the subject's DNA is to the chip's representative mutated and standard DNA sequences. The DNA that binds is identified by software, and the result indicates the subject's variations

along with the software to analyze and manage that information. Mutations, alone and when combined with varied drug regimens, can be analyzed by computer to one day ascertain certain predictable health outcomes—information physicians, dentists, insurers, employers, and potential spouses may want to know.

But does the individual want to know?

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*Dentists, often so bogged down in paperwork they have no time to search the Internet, may be shocked to find that their patients are sometimes better informed on the latest dental discoveries than they are.*

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from and affinity with standard and mutated DNA. More than 12,000 genes fit on one chip. This information may correlate with specific diseases and therapeutic responses that could be critical knowledge for managing a disease and prescribing the right drugs—"pharmacogenomics."

With pharmaceutical companies profiting significantly by advertising directly to consumers, they are driving the explosive development of pharmacogenomics. In dental practices, which prescribe mostly antibiotics and pain medications, the benefits will likely come in the package of genetically tailored pain medicines. This is because patients' genes alter their response to pain. In contrast, resistance to antibiotics is more a function of bacterial genetics, not human genetics. Lawrence Tabak, DDS, PhD, director of the National Institute of Dental and Craniofacial Research, said "Genetic tests will also increasingly be used to identify individual predictors of drug response so that effective therapies can be prescribed sooner, potentially toxic side effects avoided, and diseases more effectively and economically managed."

Affymetrix offers a scanner for electronically recording which gene sequences were found on the DNA chip,

### Will Patients Want To Know?

The general public, including dental patients, are divided as to whether they want to know their genetic predisposition for diseases and disorders.

When it comes to a genetic basis for periodontal disease, Interleukin Genetics did some market research and reported more than 90% of patients surveyed would want to know the information "if their dentist said it would be useful."

Other sources report that a greater percentage of people are fearful of knowing what invisible diseases silently lurk beneath their skin.

Harold Slavkin, DDS, PhD, former director of the NIDCR and current dean of the University of Southern California School of Dentistry, said that "denial" is an important human mechanism for coping with life, nonetheless "each of us can use denial or choose to live through information and knowledge."

A recent American Medical Association survey and other researchers have found that about half of patients want to know their genetic risk factors. Genes for diseases that cannot yet be cured, such as cancer and Alzheimer's, may be information in the "I don't want to know" category.

Tests for genes linked with more cos-

## Implications of the New Biology

metic and controllable diseases may be more amenable to patients' psyches, and therefore may experience more demand.

### Dentistry's Only Genetic Test

When it comes to dentistry, the only genetic test available is the PST Genetic Susceptibility Test for Periodontal Disease. The company holding the polymorphism's patent—and those for several other systemic diseases—Interleukin Genetics in Waltham, Mass., made the PST test available for dental research and clinical use in 1997, the same year Dolly the sheep was cloned. More than 7,000 PST tests have been processed.

Ken Kornman, DDS, PhD, of Newton, Mass., is one of the early investigators studying the specific interleukin-1 (IL-1) genetic marker associated with periodontal disease for which the test checks. According to Kornman, the chief scientific officer and co-founder of Interleukin Genetics and a professor of microbiology at the University of Texas Health Science Center, the test doesn't determine whether a patient has

periodontal disease but whether he or she has a gene mutation that increases the risk for advanced periodontal disease and the chance of losing teeth. The PST screens for two polymorphisms in the genes for IL-alpha and IL-beta that regulate the activity of the cytokine IL-1. IL-1 is involved in the control of inflammation and immune response in various spots in the body. For PST's purposes, the focus is on periodontal disease.

The benefits and limitations of finding one's PST status are subject to debate.

Michael McGuire, DDS, of Houston, is the president of the American Academy of Periodontology. He has performed research for Interleukin Genetics by using the PST test in his periodontal practice. McGuire said the test's usefulness lies in its capability to identify patients who have a polymorphism that causes their body to over produce IL-1. IL-1, which the body normally produces to help destroy microbes in response to a bacterial challenge, is fine in normal amounts. Overproducers of IL-1, however, have excessive inflammation that

appears to result in destruction of bone and connective tissues in the periodontium. Those with IL-1 are almost three times more likely to lose teeth than someone who is IL-1 negative, according to McGuire. Although initially offered as a finger-prick blood test, testing now involves taking a cheek swab and mailing it to a lab. One week later, the results arrive and the patient is given the news: positive or negative status.

"If I have the gene for periodontal disease, I want to know because I'm forewarned and forearmed. Perio is preventable so you can take charge," McGuire said.

The "preventable" part indicates that even positive status isn't a death sentence for patients' teeth and periodontal health. It just means extra oral care is needed. Tabak is concerned, however, about positive tests leading to exaggerated concern by the patient and being used to support unnecessary interventions by dentists. Likewise, "Inconclusive tests can result in a false sense of security in some patients. Negative results may be interpreted as a

### The Human Genome Project Facts

- A genome is the complete set of genetic instructions carried within a single cell of an organism. In each cell is DNA, which is composed of chemical bases represented by four letters. Determining the order of those bases is "sequencing." That sequencing results in a person's genome, which will tell health professionals the instructions for everything a patient's cell does.
- The Human Genome Project was begun in 1990; by June of 2000, the project's Public Consortium and Celera Genomics announced a working draft of the sequence of the human genome—95% of the genetic blueprint for a human being was complete in 2002. It is 99.9% accurate.
- Twenty different human genomes have been used for the basic work, and about 1,000 others have been used for annotations and further detail analysis. The largest difference discovered between two people has been 0.1%.
- Anyone with Internet access can go to three public databases funded by U.S. National Institutes of Health, U.S. Department of Energy, Wellcome Trust in England, and others, to see each deciphered piece of DNA code. 75,000 people from academia, industry, and corporations across the globe search this information daily at no charge.
- More than 1,000 scientists from six countries, including the United States, are sequencing the human genome.
- The sequencing effort is tightly coordinated to minimize duplication of effort.
- Data are deposited by scientists into public databases every day, twenty-four hours a day.
- To sit down and read the amount of information generated by the Human Genome would take twenty-six years of round-the-clock reading time.
- \$3 billion has been funded for 1990-2005; the tab to produce the working draft is \$300 million.
- Preliminary benefits of the working draft sequence: thousands of genes and about a million polymorphisms (mutations). For example, the breast cancer susceptibility gene, as well as genes for several other disorders, most fatal; also a leukemia drug that in preliminary trials, appears positive, and gene therapy for Parkinson's that appears promising in monkeys.

reason to bypass needed procedures," Tabak said.

The limits of the PST test lie in its scope: Only 30% of diseased patients are PST positive. But the remainder can still get severe periodontal disease, just as those who are positive can remain disease-free for their lifetime.

Another percentage cited comes from a November 2000 study in the *Journal of Periodontology* by John Gunsolley, DDS, MS, and colleagues on periodontal health and genetic risk in identical and fraternal twins. The investigators found that approximately half of the variance in periodontal disease can be attributed to genetic differences.

Not only is periodontal disease multifactorial, but researchers admit that a number of genes may affect susceptibility—and all these factors may differ among races and ethnicities.

"Periodontal disease is a lot like heart disease: It depends on risk factors. For heart disease, it's cholesterol, weight, smoking, exercise, family history. It's similar in periodontal disease, where bacteria are the cause and two major risk factors are genetics and smoking. Secondary risk factors—amplifiers—are stress, systemic diseases, hygiene and care, and medications," McGuire explained.

Researchers of dental disease and genetics have been known to recite: "Like no bug is an island, not every polymorphism is an island." Ken Kornman commented on the saying by connecting bacterial tests for *P. Gingivalis* and the genetic test for perio: "Many dentists use the PST test (prognostic) together with microbiological testing (diagnostic) to get a more complete picture of the current status and future risk for disease progression."

Meanwhile, there is less genetic research being performed to pursue a "caries gene" than periodontal genes. Caries is often seen in people with certain gene-based disorders such as Sjogren's syndrome. Researchers are debating the role of the host's gene-related systemic immune response in caries. One rat study showed a 50%

genetic link to caries. Yet, most scientists believe caries—more preventable than periodontal disease—is related more to virulent bacteria than genetic variation in the pathogens and their hosts. Because it is a controllable oral disease perceived by most to have little systemic consequence, the commercialization potential needed to fund the exploration for a genetic link is not as strong as it is for other diseases.

Slavkin has often stated that every disease and condition except trauma or physical accidents has a major genetic component—although not necessarily a causative component. Everyone inter-

Skeptics say a patient's PST status is a moot point, even "information overload," as it doesn't change the treatment plan, which is often aggressive for all patients with advanced perio disease. To that line of thinking, the test's proponents counter that they prefer a conservative approach using individualized treatment.

"I'm against overtreatment," McGuire commented.

Michael Lynch, DMD, PhD, from the Council on Scientific Affairs at the American Dental Association, wants dentists to temper their zeal for dentistry's first genetic test. "It has limited

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***As genetic discoveries affecting dentistry continue to emerge in the next few years, they will no doubt radically alter some of the basic concepts of disease and its management as taught in dental schools.***

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viewed for this article agrees that diseases are multifactorial, and the genetic component is far from being the sole predictive card in the deck.

In McGuire's opinion, the PST test's advantage lies in its capability to help clinicians make treatment decisions about whether to maintain or extract a questionable tooth. For general practitioners, the result may tip the scales as to whether to refer a case to a periodontist. In addition, McGuire claims positive PST status can be likened to the "proof" an intraoral camera produces. Not only is it good for case acceptance, it can work as a motivational tool for some patients who reportedly practice extra vigilant hygiene once they learn the "bad news" of their predisposition to gum disease. Yet, some studies find compliance with doctor-prescribed pharmaceuticals for even serious diseases hovers at 50%. So, when no one quite understands why an elderly patient won't consistently take his high blood pressure pills, how can a dentist be sure the PST-positive periodontitis patient will floss?

value in that it tells us when a non-smoker has slightly more risk," Lynch cautioned, adding that dentists should not think of it as a stand-alone tool for predicting periodontal disease.

"A lot of health problems are not the result of one deficiency, but a complex of genes," Lynch said. "There's a lot of overlap that builds in compensation. Except for the extreme cases of single-gene diseases, one genetic deficiency isn't going to be enough to create a problem."

NIDCR's Tabak said he has some concern about premature integration of genetic testing in the dental practice. Before validity and utility are strongly established and providers have adequate knowledge of genetics, there are risks of genetic testing for dental, oral, and craniofacial susceptibilities, just as there are for breast and colon cancer, diabetes, and heart disease. "This can lead to exaggerations about the prognostic and therapeutic implications of testing," Tabak explained.

For a fairly innocuous genetic periodontal disease test, the insurance indus-

try is certainly sitting up and taking notice.

### Impact on Insurance and Benefits

A positive genetic test result for significant systemic disease, even in those who are presymptomatic, has the potential to interfere with the ability to obtain or keep health insurance or a job. Tabak agreed: "There are federal laws and laws in some states that provide some protection against genetic discrimination, but no law covers every individual in every situation."

The screening test for the hereditary Huntington's gene was approved for use in 2000 for assessing risk and setting premiums by British life and health

information to its members that was provided to them from insurance companies to whom people have availed their medical liabilities. A spokesperson for the bureau said they do not have codes for genetic susceptibilities. They would not, however, indicate if they would refuse receipt of genetic test results or gene-based disease data if acquired indirectly.

The bureau does not collect dental information. In fact, because dental disease isn't as costly for insurers as, say, diabetes, there may never be a national database of oral health status from which dental patients would need to hide their positive PST test results. No doubt dental insurers are keeping their own files on their members' claims so it is uncertain what could evolve in the future.

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*A positive genetic test result for significant systemic disease, even in those who are presymptomatic, has the potential to interfere with the ability to obtain or keep health insurance or a job.*

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insurers. Standard diagnostic tests for seven diseases—including Alzheimer's and breast cancer—are already used. The Huntington's ruling, however, paves the way for using genetic tests for insurance consideration—something Americans fear will eventually be adopted in the states. Especially worrisome is the idea that genetic liabilities may overshadow one's current health, no matter how robust. U.S. governmental health agencies and insurers are watching the situation overseas closely. Individuals will not be asked to have a genetic test before obtaining insurance, but if they have already been tested, the data that cannot be hidden from insurance companies asking for a health history. There is speculation as to whether this will discourage people from getting tested to learn their genetic susceptibilities, which in turn will prevent them from seeking treatment or changing health habits.

In the United States, the Medical Information Bureau makes available

Howard Bailit, DMD, PhD, professor and director of the Health Policy and Primary Care Research Center, School of Medicine, University of Connecticut Health Center, has a lot of experience in this area. He's also a research associate at the Sloan Managed Care Industry Center at Harvard and a former Aetna Health Plans vice president for medical policies and programs.

Almost all employer-based dental insurance is sold as a group policy without underwriting at the individual member level, according to Bailit. So actuaries wouldn't access the genetic susceptibility of individuals unless the group being underwritten is small, such as in dental offices where there may be ten or fewer employees. In that case, as with individual dental insurance policies, "Data on genetic susceptibility could be used to influence rates charged, unless state law prevents the use of this information by insurers," Bailit said.

Because PST positive status does not "strongly link" the patient to periodontal disease susceptibility just yet, according to Bailit, it will not influence rate setting.

Of course, insurance companies always leave open their options for why and when and how much they can raise premiums.

Dental insurers so far are not interested in picking up the \$120 tab for the PST test, because employers aren't interested in higher premiums. A state law mandating coverage of genetic tests would be the only thing to get them interested.

Most people in the dental insurance industry agree that a strong argument can be made for managing (approving/denying) treatments on the basis of a patient's risk for disease. So far, when it comes to caries, insurers are intrigued by the idea of controls or limits on procedures based on degree of risk. Bailit thinks genetic risk would be even more difficult, "That type of benefit program would be very difficult to market and impossible to administer."

In fact, the dental insurance industry doesn't know what to make of the new PST test. The test's manufacturer says PST positive status is correlated with increased risk of future tooth loss, but the insurance industry says this doesn't mean the PST has "positive predictive value." One insurance group agreed to join the PST's manufacturer to sponsor a study to gather more data on the PST test.

Michael del Aguila, MS, PhD, is an epidemiologist and director of outcomes assessment for Washington Dental Service, a member of the Delta Dental Plans Association. He is sponsoring the research being performed at the University of Washington School of Dentistry to quantify the relationship between PST genotype status and utilization of dental services by patients in a dental plan. Insurers such as the Washington Dental Service want to target resources appropriately. If the evidence demonstrates that those who are PST positive are more likely to use periodontal dental services, they can receive

earlier coverage for services that may slow the progression of the disease. This in turn could minimize more costly complications due to advanced disease (bridges, partials, dentures, implants) and contribute to improved oral quality of life for patients.

"We want to know the total cost and treatment over time of those with PST positive vs. negative status. If it has value in letting dentists know which patients will need care in the future, why not authorize and provide treatment now?" del Aguila asked.

The study began a year ago and has faced challenges recruiting patients. del Aguila didn't speculate as to the reason behind the reluctance of subjects who declined participation. It may have been inadequate compensation for their level of effort. Or perhaps they did not trust how a dental insurance company would use the information.

The study has currently been reconfigured to take advantages of changes in collection of the PST (cheek swabs vs. fingerprick) that allow patients to perform it in their own homes.

### Privacy and Ethical Issues

Seven out of ten Americans are concerned about their employers or insurance companies accessing their genetic information and using it against them, according to a 1998 *American Medical News* article.

The National Human Genome Research Institute reports that 90% of people it surveyed think employers should be prohibited from obtaining employees' genetic data, and 60% said they won't take a genetic test if they think employers and insurers can access the results.

Federal employees in 2000 were protected by an Executive Order signed by President Clinton; however, a Patients' Bill of Rights Act with protection against genetic discrimination is needed. State legislation is pending across the country and has passed in twenty-three states to enhance patients' rights and protections. But Americans have a responsibility to keep informed as to

how to protect their privacy and voice their concerns about the vulnerability of their medical data to their legislative representatives.

The Human Genome Project itself does not pose ethical dilemmas, but use of its findings will.

Slavkin favors the following analogy: "Like the Periodic Table of Elements from the 19th century, the Human Genome Project is without values per se, but raises profound ethical issues regarding the uses of this knowledge base."

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### *A Patients' Bill of Rights Act with protection against genetic discrimination is needed.*

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### Online Health Histories

In fact, companies are mining the genome project's draft map of a human being for genes and their polymorphic errors or variations as you read this. From it they develop tests using organisms like yeast and lab animals, and sometimes plan to put them through clinical trials on humans.

Dentists one day may offer or even recommend patients take tests that go well beyond dental diseases. Patients may come into the office already having taken such a test at another medical or dental office and know the full spectrum of their health-related susceptibilities.

In 2010, a "Dr. Marks" may see a new fifteen-year-old dental patient, Sophia, who made her appointment via the Internet. Sophia tells Dr. Marks she has the gene for juvenile onset periodontal disease, not to mention alcoholism, "which means I have to stop at two drinks, or else" she opines, sighing with adolescent drama. Dr. Marks asks if she brought her history on a card or does he need to retrieve it. Sophia, like all Americans, has her certified DNA map stored on an electronically secure site, with portions she can make accessible to her health care providers or potential insurers via a changeable password. However, after reading about full-site hackings using passwords, she decided

to bring Dr. Marks her medical and dental history and genetic data on a portable health card with a computer chip. In any case, neither source will allow copying or a printout for security and legal purposes, though reports of bypassing technology surface.

Although a recent survey by the Pew Internet and American Life Project confirmed that in the year 2000, 63% of Americans were opposed to keeping their medical records online even with a password-protected site for fear others

would see it, expediency will trump public opinion. History is our teacher—remember when one's social security number was forbidden to be used as personal identification for any reason except for its express purpose? Today, Americans' formerly secret social security numbers are used for credit cards, bank account passwords, and appear on most drivers' licenses, even on personal checks handed to the pizza delivery guy.

Stanley Surabian, DDS, JD, is chief of Dental Services for Community Medical Centers, and Program Director of the General Practice Residency in Dentistry program at University Medical Center in Fresno, California. Surabian said he has noticed a trend in a loosening of privacy safeguarding, "Our nation became diverted from the limitation for widespread generalized use of the social security number. Who knows what could happen with genetic data?"

Slavkin has some idea, "The military are advanced in using genotype for identification on microchips," he said.

Attorney Curley has this vision of the future: "A patient will issue their medical record authorization code and the doctor's computer will access the entire medical history of the patient stored on the Internet. The dentist's office will have a 'smart program' that will filter the information with dental issue prior-

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ities and alert the doctor to any significant issues to review, or order up prior test results and digital images—also stored on the net.”

In years to come, dentists will not only request a patient's full health history, complete with molecular data, but that of the patient's family members (at least as it applies to oral health). Genetic susceptibilities for conditions such as oral cancer and periodontitis may be information shared among family members. If a sibling knows his brother has the oral cancer gene, he'll have the opportunity to get tested, quit chewing smokeless tobacco, and pursue individualized gene therapy treatment, which will increasingly be made available for such conditions.

to be retained at different ages. It should not be surprising if the insurance industry pursues this technology.

### Dental Geneticists

Gene therapy is in its infancy—mostly in animal research—and is not an established mainline clinical modality.

Lynch of the ADA envisions that gene therapy will be used only when significant morbidity and mortality is involved. “Periodontal disease is not on the radar for that,” he theorized. Likewise, he doubts that a dental genetic specialty organization would be able to obtain recognized dental specialty status.

Other dental scientists and researchers disagree.

Tabak, for one, is comfortable using the term “dental geneticists” to describe dental researchers who have received advanced training in genetics and pursue genetic research for dental applications. Likewise, he thinks there may also be geneticists with special knowledge of oral health. “They will conduct basic and epidemiological research on the genetic underpinnings of dental, oral, and craniofacial conditions. In the clinic, they will consult on the dental and oral manifestations of craniofacial conditions or rare systemic diseases that require more specialized genetics expertise than that required of a general dentist.”

Tabak noted that although there are craniofacial genetics courses, he is not aware of a set course of study for dental students who wish to become dental geneticists. However, NIDCR has an interest in furthering genetics education in dentistry, so it, as well as other NIH institutions, recently announced their involvement in the Ethical Legal and Social Implications of Human Genetics and Genomic Research Education Grant Program. Applications will be accepted by NIDCR from for-profit and non-profit public or private organizations and agencies. Activities eligible for funding include developing courses, conferences, and curriculum and many other means for improving professional and lay understanding about genetics, related technology, and its ethical, legal and social implications. Schools and organizations interested in applying for a grant can contact the NIDCR's Office of Training and Career Development, Division of Extramural Research (Dr. James Lipton, assistant director of the office, can be reached at (301) 594-2618 or James\_Lipton@nih.gov).

Dental researchers are working at a breakneck pace to study not only genetic susceptibilities, but also pharmacogenetics and tissue engineering/biomimetics in vitro and in vivo. They'll also study cell cloning, which will one day become commonplace to generate and replace defective or aging organs and tissues. This technology is much like that of physicians in the news recently who

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### *The Human Genome Project itself does not pose ethical dilemmas, but use of its findings will.*

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The National Coalition for Health Professional Education in Genetics is developing a tool for eliciting a comprehensive, multigenerational family history. Once it is finished, NIDCR—a member of the coalition—may help adapt it and disseminate it to dentists.

A patient's own and familial oral and general health histories will be integrated information for “disease management”—a term popping up lately almost as often as “evidence-based dentistry.” Disease management involves the coordinated prevention or delay of a particular disease, early and more accurate diagnosis, treatment planning, and outcome prediction to reduce costs and improve outcomes.

More and more, health care providers will be making judgments about genetic test results. Computer programs may even be created that assign weights to risk factors (including genes and home hygiene pattern), disease, treatment, therapy administered, and genetic reception to that therapy. The software will crunch the numbers and output a percentage of the patient's teeth predicted

Tabak admitted that current research on genetic therapy in dentistry is limited to animals. In fact, he said he cannot speculate about when and where the pioneering research of gene therapy for dental disease will occur on humans. He does, however, believe it is just a matter of time.

“The Human Genome Project will identify the players in the complex cascade of gene activation and deactivation involved in tissue repair and that encode proteins that endow cells with key functions,” Tabak predicted. He named candidates for periodontal disease thus far as polymorphisms in the IL-1, IL-10, TNF-alpha and cathepsin C gene; and in the cell receptors for IgG and vitamin D and the HLA marker. Genes responsible for defective tooth enamel formation, decreased salivary gland function, and immune dysfunction and others are associated with caries.

After all the players are determined in the next few years, researchers can study how to modulate the cascade to enhance healing in reconstructive surgery, change function, and more.

soon plan to try repairing weakly pumping hearts in patients who have had congestive heart failure using new muscle and blood vessel fashioned from the patient's own cells.

Bruce Baum, DMD, PhD, chief of the NIDCR's Gene Therapy and Therapeutics Branch, said the dentist as gene therapist is not only possible, but will be reality for today's dental students by the time they reach their "midpractice lifetime." His research in gene transfer technology and the regulation of salivary gland secretion is widely published. It was only natural when he questioned the need for therapeutically injecting genetically engineered proteins (current method) when the same therapy could be less costly and more easily performed using one of the body's built-in, slow-release pumps: the salivary gland. In his research on laboratory animals, he has proved his theory and already transferred therapeutic genes to salivary glands with good results. He has used this approach to repair irradiation-damaged salivary glands, as well as kill an azole-resistant *Candida* species using a therapeutic course of gene expression (ten to fourteen days). He's also used this transfer route to deliver genes for therapeutic proteins for endocrine secretion. The glands then can produce and secrete "transgene-encoded proteins" systemically so that they circulate in the bloodstream to treat certain single-protein deficiency diseases such as human growth hormone deficiency or hemophilia. Baum hopes to begin to use his findings in human trials within two years.

If salivary gland gene transfer proves highly efficient and effective, not only for oral disease but also as a modality for therapeutic gene transfer for systemic disease in humans, the possibility of dentists administering gene therapy for health purposes beyond the oral cavity is real.

Slavkin used Baum's work as an example to explain the mechanics for one method of delivering gene-mediated therapy for local or systemic benefit. Besides injection into the salivary glands, genes can be injected into the mucosa, gingivae, tongue and muscula-

ture. They can also be inhaled through oral and nasal mucosa.

Explained Slavkin: "The 'gene' is delivered as 'naked' DNA or encased in a viral vector (carrier) that has the facility to bind cell surfaces and become engulfed or absorbed or phagocytosized by normal cellular processes. The gene delivery has often been developed to mimic the ways that viruses invade cells; adenoviruses are superb at entering oral and nasal cells."

### Safety of Gene Therapy

Genetic researchers have found adenoviruses are the best vectors for testing therapeutic genes, although they pose problems for long-term use. In his work with salivary glands, Baum considers safety concerns the priority.

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*Dental researchers are working at a breakneck pace to study not only genetic susceptibilities, but also pharmacogenetics and tissue engineering/biomimetics in vitro and in vivo.*

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In 1999, Jesse Gelsinger, an eighteen-year-old student at the University of Pennsylvania died from a toxic reaction four days after starting experimental gene therapy treatment. His liver had been injected with virus-bearing genes to correct his genetic liver disorder. Ever since gene therapy's first casualty, safety questions have dogged researchers. The university reported to the Food and Drug Administration that procedural errors were made, but the event could not have been anticipated. Still, the program was temporarily halted, and federal and Congressional scrutiny has begun in the fledgling field. The fact that during adenoviral manufacture contamination with HIV and hepatitis C viruses is a possibility—albeit rare—in itself draws attention.

Slavkin sees the accident this way: "In important clinical research, people can die and do die. In the case of the teenager in Pennsylvania, all accounts indicate poor handling of the clinical

protocol and the health of the teenager as well as failure to provide informed consent to the parents. This tragedy could have been avoided in the specifics. Meanwhile, adverse effects do appear in clinical trials, and the public needs to understand that clinical trials for life-threatening diseases do have risks."

For now, whatever tinkering is done to therapeutically alter human genes cannot be passed on to our offspring.

Slavkin explained that humans consist of somatic cells and germ cells. "Germ cells are only found in gonads (ovaries and testicles). Everything else is made of somatic cells, and each somatic cell contains the same human genome encased in twenty-three pairs of chromosomes. Gene-mediated therapy can be performed in germ as well as somatic

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cells. Modifications to somatic cells are not inherited. The gene-mediation may last for days or weeks, or could last for a lifetime if inserted in to stem cells. Federal guidelines today limit therapy to somatic cells," Slavkin said.

There is comfort in knowing if therapy for a potential problem linked to a polymorphism is botched or if unwanted side effects emerge, the gene therapist should be able to switch off the gene or perform therapy with the opposite effect to reverse course—even if it was to be a "permanent change" to stem-type somatic cells. But even if it is a permanent change that for some reason cannot fully be undone, at least it will not be passed onto children. Restrictions to prohibit germ cell genetic research exist in every country.

### Integrating With Medicine

In the era of biodentistry, the future model of the dental practice is being debated. Parts of dentistry will probably

## Implications of the New Biology

overlap with medicine, as they do now.

For example, a patient calling his doctor's office to describe a classic blocked salivary gland beneath the tongue is scheduled to see the physician, who then refers to an ear, nose, and throat specialist. Why isn't the nurse taking the patient's call instructed to direct the patient to a doctor of dental medicine, who would have more appropriate judgment and could refer to an oral surgeon if need be? These apparent "turf wars" and separate territories will continue if something doesn't change.

Many think that dental practices that offer genetic testing for a host of systemic diseases beyond oral diseases will be "networked" with genetic counseling and treatment. Perhaps general dentists will still be solo or group practitioners who refer to specialists. Or maybe dentists will become part of a broader group health model—the multidisciplinary health clinic owned by one health care system that offers a full range of services: medical, nursing, dental, podiatric, ophthalmic, obstetric/embryology, pediatric, audiology, oncology, etc. At such a site, genetic tests for every aspect of human health will be offered with genetic and psychological counseling as well. The idea is to provide a full-spectrum of health care providers within close proximity to more easily treat the patient along a seamless continuum of care.

Dentists are not currently trained to do any genetic counseling, let alone han-

dle counseling patients given test results that they believe lessen their quality of life or shorten their lifespans. In fact, in a 1998 study on providing genetic test results reported in a *Journal of the American Medical Association* article, only one in five patients received the appropriate genetic counseling to accompany test results positive for genetic risk of cancer.

If dentistry doesn't begin carving out a niche in genetics, medicine will claim it.

"The oral health professions, government, and industry need to work together to make this a reality or it will flower in a medical specialty area such as ENT or pediatrics," Slavkin said.

### Genetics Curriculum

In a *New England Journal of Medicine* report a few years ago, physicians had misinterpreted one-third of predictive test results for colon cancer. Physicians need more genetic training and so do dentists.

The first basic genetic course anyone can recall being offered in a dental school was back in the early '90s. It is a decade later, and not every dental school offers a genetics course. In fact, it is barely mentioned in many dental schools and not at all in most large dental meetings where continuing education courses are held.

Rachel Morrissey, manager of education and institutional surveys at the

American Dental Association Survey Center, reported that she collects information from all dental schools on how many clock hours they spend on basic science and clinical science.

"We have a graph with different disciplines within basic science. Twelve categories are represented, and except for 'other,' genetics is the least taught of all disciplines, and physiology is the most," Morrissey said.

In the 1997-98 academic year, forty-two of fifty-five dental schools surveyed covered "some genetics." During four years of dental school, the high was 110 clock hours by Harvard School of Dental Medicine, the low was one clock hour by the University of Texas Health Science Center at San Antonio Dental School. The mean average number of clock hours of genetics taught during dental school for all schools is 13.4 hours.

The Survey Center recently surveyed dental schools again. When the results are released later this year, it will be interesting to see if genetics is taught in more schools and covered more thoroughly.

In an encouraging estimate, Slavkin speculated that NIH and industry grant support indicates to him that about one-quarter of dental schools have been involved in some molecular genetic research.

Dental organizations have been publishing genetics research articles but have yet to produce any consensus statements or patient education materials on

### Genetic Web Sites

- The National Human Genome Research Institute: [www.nhgri.nih.gov/](http://www.nhgri.nih.gov/) (source for how many genes are mapped thus far)
- NICDR: [nidr.nih.gov](http://nidr.nih.gov)
- GenBank: [www.ncbi.nlm.nih.gov/Genbank/GenbankOverview.html](http://www.ncbi.nlm.nih.gov/Genbank/GenbankOverview.html)
- Links of some useful resources for human genome data searches, Human Genome Central: [www.ensembl.org/genome/central](http://www.ensembl.org/genome/central)
- Interleukin Genetics: [ilgenetics.com](http://ilgenetics.com)
- Human Genome news: [www.ornl.gov/hgmis](http://www.ornl.gov/hgmis)
- Ethical, legal, and social implications of genome research on privacy/confidentiality: [www.ornl.gov/hgmis/elsi/elsi.html](http://www.ornl.gov/hgmis/elsi/elsi.html)
- American Society of Human Genetics: [www.faseb.org/genetics](http://www.faseb.org/genetics)
- National Coalition for Health Professional Education in Genetics: [www.nchpeg.org](http://www.nchpeg.org)

genetic testing.

Both dental schools and professional societies must play a central role in educating the nation's dental and oral hygiene professionals on their role in how best to utilize the applications of advancing genetic research and in providing related services, according to Tabak.

"Every attempt needs to be made to train faculty and to reform current curricula and licensure examinations" for the next generation of dental health care professionals. At the same time, current dental professionals need education and updates on "the emerging importance, benefits, and risks for their patients of genetic information and gene-based therapies," Tabak said.

The National Coalition for Health Professional Education in Genetics, formed by the AMA in 1996, will soon issue a set of core competencies in genetics that will outline the minimum knowledge, skills, and attitudes necessary for health professionals, including dentists, to provide high-quality care to patients in this era of genetics. A draft landed in the hands of some dental society board members and leaders charged with modifying educational curriculum. Under way are discussions in some schools as to how they could begin assessing their existing genetic offerings and their faculty's expertise for teaching genetics. These discussions will help

determine needs in formulating just how these competencies could be integrated into their curricula.

Baum from NIDCR has stressed for some time the need to introduce the concept of gene therapy—not just basic genetics—into the dental curriculum. Baum believes that practitioners could be using the salivary glands for gene transfer as early as 2010.

### Molecular Dentistry in the Average Practice

Leaps in science and technology knowledge mean the finished map of the human genome will be completed ahead of schedule. Originally set for 2005, researchers are now saying 2003 is a real possibility. The compounding understanding from each small discovery is flattening out the learning curve for the Human Genome Project's researchers. What researchers can sequence in one minute today, took twenty minutes three years ago, and a year or more twenty years ago.

Ten years from now, when general dentists encounter cancer patients with damaged salivary glands from irradiation therapy, they may refer the patients to a dental geneticist, or perhaps an oral surgeon or periodontist with special gene transfer education to restore the glands' function in moving water. Or, they may just do it themselves if they received the

proper continuing education.

By 2010, all dentists will know how to interpret genetic test results and their implications that affect oral health, or refer to someone who does in "complicated cases." "Dentists and dental hygienists will need to make informed decisions about the application of new gene-based drugs and therapies, and to understand the psychological, ethical, legal, and social implications related to the use of genetic information and technologies," Tabak said.

### Conclusion

This article discussed the changes and challenges in how oral health will soon be managed in the emerging era of genetic dentistry. We are living in a time when cloning—not long ago dismissed as "science fiction"—has become a reality. The principle of genetic manipulation to counter cellular aging is yet another vista for research. Our genome—a genetic thumbprint—will provide health professionals with the instructions for everything our cell does, from the time we began dividing into a zygote to the day we die. Nothing akin to this has ever graced science in the history of the world. Indeed the most momentous impact of the Human Genome Project upon humankind will probably unfold in ways we can't begin to imagine.

# Advances in Caries Diagnostics and the Changing Face of Dental Practice

Wendy E. Mouradian, MD, MS  
Joel H. Berg, DDS, MS

## Abstract

Advances in scientific understanding of disease processes and diagnostic technology will lead to changes in the ways caries is managed. These changes will include new relationships with patients that will call for greater skills in the behavioral sciences. Specifically, there will be a need for greater understanding of the biopsychosocial and the socio-cultural bases of disease and health care behavior and enhanced communication skills. The need to understand and respond to demographic forces—especially those that involve population groups at increased risk—and to work collaboratively with medicine will also assume greater significance.

**D**entistry is entering a new era of diagnosis, disease management, and treatment strategies. The most common dental disease—the most ubiquitous disease of humans—is still dental caries. To understand the future of dental practice requires peering into and anticipating the scientific frontiers in this field. Other reviewers have considered advances in molecular cardiology, including bacterial adhesion mecha-

nisms, bacterial typing, genetic susceptibility, and caries vaccines, all of which could greatly enhance the dental practice of the future. But much closer to market readiness are advances in caries diagnosis and management. Some are already on the market, if not widely employed. Unlike many new technologies that require greater technical expertise such as, for example, implantology and its required prosthodontic care, advances in caries treatment will require greater attention to interpersonal skills of patient management, including behavioral and socio-cultural issues, dentist-patient relationships, and collaboration with other health care practitioners. This paper will focus on advances in caries diagnosis and the implications for today's oral health practitioners.

## Caries Remains a Significant Problem

Although the use of fluoride and other advances in professional care have led to much improved oral health in recent decades, caries incidence remains high. Our understanding of the caries process has illuminated the role of pathogenic bacteria, biofilms, and dietary factors. Yet the majority of Americans still acquire the disease by late adolescence. And in sub-populations—ethnic

minorities, socially or economically disadvantaged groups, and those with disabilities or special health needs—disease rates are higher. Most worrisome are high rates of disease in children. These health disparities, summarized by *Oral Health in America: A Report of the Surgeon General* (U. S. Department of Health and Human Services, 2000) and others call for increased attention to the needs of populations who do not enjoy the benefits of good oral health (U.S. Department of Health and Human Services, 2003b). It is for these popula-



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tions in particular that new caries diagnostic measures may hold the greatest potential.

### Advances in Caries Diagnosis

In a milieu of increasingly sophisticated technologies applied to health care, commonly employed caries diagnostic approaches have not progressed beyond the explorer and mirror, transillumination, and x-rays, all of which employ technologies well over fifty years old. Although remineralization of caries lesion *in vitro* has been documented for decades (Silverstone, 1982), techniques available to dentists now do not allow for detection of lesions early enough in the demineralization process. Newer technologies under active development and clinical study will allow practitioners to see caries lesions at an early enough stage for medicinal interventions to be effective.

For example, quantitative light-induced fluorescence (QLF), currently used as a research tool (Buchalla, Lennon, van der Veen, and Stookey, 2002), can be used to scan an entire tooth and, with analytic software, determine the extent of demineralization. Remineralization therapies, such as concentrated fluoride varnish regimens, proven to be effective *in vitro* (Hazelrigg, Dean, and Fontana, 2003), could be applied *in vivo*.

Digital imaging fiber optic transillumination (DIFOTI) also has promise as a technique to detect caries lesions earlier than visual examination or radiographic examination can. *In vitro* work has shown this device to be more sensitive than currently-used techniques (Schneiderman et al, 1997). If on-going clinical studies confirm greater sensitivity, this device might be useful in providing clinicians with indications for medicinal therapies or radiographic assessment.

**Medicinal Approaches:** Until now, potential manufacturers have been reluctant to invest in improving clinically-deliverable remineralization therapies, since the effects of such therapies on particular patient lesions could not be

demonstrated. When devices can document the progression of caries lesions and their regression with professional and home care regimens, manufacturers will have a powerful incentive to develop even more effective medicinal therapeutics targeted at specific caries lesions. Such lesion-specific remineralization will likely be combined with comprehensive oral health care to manage the infection, the host response, and the host salivary function capacity to mitigate disease progression. The plethora of new products being proposed for introduction in the U.S. market over the next year in this caries diagnostic category presages future greater investment by the dental industry in medicinal interventions. In addition to fluoride, xylitol (Lynch and Milgrom, 2003), chlorhexidine (Anderson, 2003), and other caries-retardants are under study.

measure salivary buffering capacity. Each of these products, and many others in this category, must be validated using careful analysis with caries progression studies. In particular, there is a need to validate one or more of the early diagnostic technologies in relation to the currently employed "gold-standard"—cavitation as an outcome measure.

It is likely that the new, sophisticated caries diagnostic techniques, alone or in combination, will contribute to the development of such validated risk assessment tools. Research into early diagnosis presents an opportunity to determine in what setting lesions progress, thus allowing for guided behavioral and professional interventions to arrest the caries process. Such an advance will encourage practitioners and their patients to become partners in overall management of caries as a dis-

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*Until now, potential manufacturers of medicinal therapies have been reluctant to invest in improving clinically-deliverable remineralization therapies, since the effects of such therapies on particular patients or lesions could not be demonstrated.*

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**Risk Assessment:** Various strategies have been proposed to categorize patients into levels of risk for caries utilizing clinical and environmental risk factors (e.g., dietary habits, practice of oral hygiene, fluoride exposure, and in the case of children, past history of caries as well as caries in mother/siblings, socio-demographic factors, etc.) (American Academy of Pediatric Dentistry, 2003; Centers for Disease Control and Prevention, 2001; Zero, Fontana, and Lennon, 2001). New technologies are being introduced that can be combined with these tools. Included in this category are products that detect lactic acid production by biofilms on the tongue, suggesting overall mouth "lactic acid activity." Other products (common in the Japanese market) look at plaque acid production potential, while still others

ease, while employing targeted lesion-specific interventions. The current need to wait years to observe cavitation is antiquated and counter-productive, and undermines greater patient involvement in health promoting behaviors.

In the midst of an apparently bright future for early caries diagnostics, there may be some potential pitfalls here. The conundrum of how to manage very early detected lesions has a parallel in many areas of medicine where sophisticated imaging techniques can identify small lesions of uncertain diagnostic significance. There may be the possibility for improper interpretation—perhaps a tendency for practitioners to drill and fill demineralized areas which might be arrested with conservative methods—out of honest or purposeful misinterpretation (Feil, Meeske, and Fortman,

1999). To avoid this, careful longitudinal studies are needed as well as a shift in dental practice to augment surgical skills with medicinal approaches.

### Implications for Practice

When dentists can identify microscopic lesions early, how should they proceed? What are the skills dentists will need to make optimal use of this information? Interventions for sub-microscopic lesions will follow current concepts of caries evolution which emphasize the triad of fermentable carbohydrates, bacteria, and a susceptible host. Careful dietary advice, oral hygiene measures,

communication skills). If dental practitioners of the future are to influence patient behaviors early in the caries process then they must concern themselves with the content of behavioral counseling they provide, the individual patient's larger psychosocial context, and the role their own behaviors may play in helping—or hindering—changes in patient's health behaviors (Butler, Rollnick, and Stott, 1996; Dworkin, 2001; Schou, 2000).

**Biopsychosocial Models of Disease:** The importance of a patient's behavioral and psychosocial context is presented in biopsychosocial models of illness, described by Engel (1980) in the

knowledge of behavioral science or of all the factors contributing to a patient's behaviors in order to intervene positively. One model of behavioral intervention that can be applied in a relatively short time frame is motivational interviewing (Emmons and Rollnick, 2001; Resnicow et al, 2002). Originally used in substance abuse counseling, this technique has been employed with success in other settings (Burke, Arkowitz, and Menchola, 2003; Resnicow et al, 2001). Emphasizing an empathic communication style, motivational interviewing involves assessing patient readiness for behavioral change, and then reinforcing steps toward the desired behavioral change. This technique has been employed in dental settings to promote oral health behavioral changes including caries-control behaviors and smoking cessation (Koerber, Crawford, and O'Connell, 2003).

**Socio-cultural Issues:** Behavioral interventions must also be provided within the context of the individual or family's social and cultural context. This aspect of the biopsychosocial model has become very important in an increasingly diverse American society. Cultural issues have received little attention within dentistry, but have been highlighted recently by Formicola and others (Donate-Bartfield and Lausten, 2002; Formicola, Stavisky, and Lewy, 2003). The interaction of oral health and cultural practices is apparent (Godson and Williams, 1996; Riedy, Weinstein, Milgrom, and Bruss, 2001). For example, high risk diet/feeding practices in some cultures, such as pre-chewing children's food or high consumption of acid snacks, can be deleterious to teeth. Health practitioners' own behaviors can play a role in maintenance of health disparities through stereotyping and differential expectations of patients of diverse cultural backgrounds, as discussed recently by the Institute of Medicine (2002) and others (Mofidi, Rozier, and King, 2002). Serving culturally diverse patients with sensitivity is a part of the larger frame of dentist-patient relationship.

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### *There is a need to validate one or more of the early diagnostic technologies in relation to the currently employed "gold-standard"—cavitation as an outcome measure.*

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and judicious use of medicinal therapies will be the cornerstones of treatment. These measures, intended to prevent or retard caries progression, will shift practitioners' focus from restorative and surgical means to medicinal ones (Steinberg, 2002). Medicinal approaches, and accompanying regimens, of necessity emphasize behavioral, socio-cultural and interpersonal aspects of dental care.

While behavioral *advice* has always been a part of dental practice, the larger issues of behavioral science have been inconsistently embraced in a field that prizes technical excellence. Behavioral issues include: (1) actual advice dentists provide to patients for behavioral changes, (2) specific methods that may be used to encourage patient behavior change, (3) behavioral issues patients bring with them (dental fears, attitudes/knowledge, health habits including oral hygiene, tobacco and alcohol use, socio-cultural issues and problems of behavior management in the dental office, such as with children), and (4) dental practitioners' own behaviors (e.g., personal biases and interpersonal com-

medical context and also applied to dentistry (Dworkin, 2001). In this paradigm, susceptibility to disease is an interaction of factors that may start with bacterial pathogens but also includes complex factors affecting patients' behaviors. In the case of caries, psychosocial and behavioral factors, including child and parent behaviors, are probably the most potent. Through parental behaviors bacterial pathogens are introduced into the oral cavity, diet and feeding practices are set, home oral care regimens are instituted, health care services are sought, and life-long oral health habits are modeled. An emphasis upon patient behaviors requires dental practitioners to have an appreciation for the importance of many interacting factors such as personal barriers, social support, stress and coping, health beliefs, and dental anxiety (Stetson, 2000). Curricular models are available that focus medical students on skills needed to provide patient-centered care in a biopsychosocial model and could be adapted for dental education (Cohen, Krackov, Black, and Holst, 2000).

It is not necessary to have exhaustive

**Dentist-patient Relationship:** The doctor-patient relationship has been the subject of much concern in medicine and is of equal importance to the dental profession (American Dental Association, 2003; Mouradian, 2002). Ethical concerns have included excessive practitioner paternalism and the need for patient autonomy; the erosion of trust by third party interference in managed care settings and excessive marketing for-profit health services (Pellegrino, 1986), increased emphasis upon technical interventions, and the general need for preserving a humanistic approach to the doctor-patient interaction (Balint, 1999).

Relatively little has been written about dentists' communication skills, and a recent survey of U.S. and Canadian dental schools reveals interpersonal communication skills receive little attention in the undergraduate dental curriculum (Yoshida, Milgrom, and Coldwell, 2002). Yet this is an important component of the dentist-patient relationship for promoting health behaviors and increasing patient satisfaction (Schouten, Eijkman, and Hoogstraten, 2003). An over-emphasis on the business of dentistry can also be a threat to the doctor-patient relationship when it results in an emphasis upon the monetary "value" of patients (Levin, 2003). Such an emphasis could undermine patient trust and the dentist's ability to bring about behavioral changes in patients.

**Vulnerable Populations:** Practitioners caring for children need a particular awareness of behavioral and socio-cultural issues. Children are at high risk for oral health disparities (Mouradian, Wehr, and Crall, 2000). Children are the poorest age-group in the U.S., and they have the highest representation from minorities. While some 37% of children are currently from ethnic minority backgrounds, by 2025 the number of children from minorities is expected to be close to one half of all children (Passel, 2002). Children are also dependent on adults for access to health services and home care practices. These unique attributes of children call for special

arrangements on the part of health systems—and health providers—to ensure children have access to needed care (Mouradian, 2001; Wehr and Jameson, 1994).

Other vulnerable groups—the elderly and those with disabilities and other special health care needs—also require special focus on social and cultural context (Mouradian and Corbin, 2003). An additional facet for dental and medical practitioners who work with these vulnerable groups is the need to form effective alliances with key family members and caretakers, in addition to patients themselves—in order to impact health outcomes. The relationship between these vulnerable patients and their caretakers is another area where sensitivity to behavioral and cultural context is very important.

for interpretation and decision-making. This would greatly help patients who lack access to dental care.

That physicians can play an important role in disease prevention, triage and dental referral is clear. Currently physicians in North Carolina, Washington and Idaho are reimbursed for application of fluoride varnishes to Medicaid-eligible children (Mouradian et al, 2003; Rozier et al, 2003). A number of other federally-funded projects are focused on training pediatric and family medicine residents to promote oral health in high risk children (U.S. Department of Health and Human Services, 2003a). Critical to the success of such efforts is the collaboration between dentists and physicians to ensure patients identified at high risk actually receive needed dental care.

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*The conundrum of how to manage very early detected lesions has a parallel in many areas of medicine where sophisticated imaging techniques can identify small lesions of uncertain diagnostic significance.*

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### Collaboration With Other Health Professionals

Advances in caries diagnostic technology may provide new avenues for collaboration with other health professionals, especially in the care of populations at increased risk for oral disease.

The availability of a validated risk assessment tool would augment the currently available clinical risk-assessment tools and enable primary care practitioners to effectively screen for oral disease and refer patients for dental care. For example, the American Academy of Pediatrics now recommends that all children have an oral health risk assessment by six-twelve months, but does not provide a clinically useful screening tool for medical practitioners (Hale, 2003). Another possibility includes the purchase of new caries diagnostic equipment by community clinics or physicians' offices in rural areas, with electronic transfer of information to dentists

Since historically dentists and physicians have more often worked in parallel than in partnership, few models exist for active collaboration. One model being employed in Washington State is collaboration between medical practices providing such services and "ABCD" networks of dentists who provide care for Medicaid-eligible infants and young children (Milgrom, Hujoel, Grembowski, and Ward, 1997; Mouradian et al, 2003).

### Summary and Conclusions

New caries diagnostic techniques will permit dentists to make early diagnosis of incipient caries lesions and document their regression with therapeutic interventions. These methods will also provide the capability of validating currently-applied models of risk assessment. Such advances will allow dentists of the future to use medicinal approaches and guide patients and families towards

more positive oral health behaviors to decrease risk of caries. In order to accomplish this goal the dental practitioner will need to focus on patients' behavioral and socio-cultural issues, and also on his or her own interpersonal communication skills and attitudes. In other words, dental caries must be conceptualized from a biopsychosocial perspective—the model system currently advocated and taught in all medical schools as the basic organizing principle by which to understand all human disease and illness. As specifically applied to caries, behavioral techniques such as motivational interviewing, for example, can be used to encourage movement toward positive health behaviors in patients. These techniques may be particularly helpful for those groups at increased risk for disease, including vulnerable groups such as children and other special populations. Such early intervention could provide an enormous boost to health promotion efforts in populations with oral health disparities.

These advances may also allow medical practitioners to screen more effectively for caries risk and judiciously refer patients at high risk for disease to dental offices. Such capability will especially benefit patients in rural areas and those without regular access to dental care. Dental educational changes are needed to better prepare dentists to engage in behavioral counseling, concentrate on effective interpersonal communication skills and work collaboratively with other health professionals.

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# On Translating New Biologic-based Interventions into Dental Practice

B. Alex White, DDS, DrPH, FACD

## Abstract

Prudent change is a professional responsibility. Four forces will influence the incorporation of the new biology into dental practice—and their individual application in various settings will lead to a range of practice characteristics. These forces include our vision of what it means to be a professional, health consequences of the new biology, infrastructure features, and incentive structures.

### *Nothing endures but change.*

— HERACLITUS (540 BC - 480 BC)  
FROM DIOGENES LAERTIUS  
LIVES OF EMINENT PHILOSOPHERS

*Change has a considerable psychological impact on the human mind. To the fearful it is threatening because it means that things may get worse. To the hopeful it is encouraging because things may get better. To the confident it is inspiring because the challenge exists to make things better. Obviously, then, one's character and frame of mind determine how readily he brings about change and how he reacts to change that is imposed on him.*

— KING WHITNEY JR., PRESIDENT  
PERSONNEL LABORATORY, INC.  
CITED IN THE WALL STREET JOURNAL  
JUNE 7, 1967

Almost daily, we learn about scientific advances—genetic discoveries, innovative pharmaceuticals, less invasive imaging and surgical techniques, and ways to grow human tissues and organs—that seemed almost unimaginable when many of us began our dental careers. The potential application of these new biologic approaches to dental practice engage our imagination about what could be and challenges us to revisit some of our understandings about human biology and our notions of what it means to be a dentist and a health care professional. Who will apply this new technology? To whom? In what setting? How will it be used? For what reasons? With what outcomes? We can also become overwhelmed by the content and magnitude of new scientific information. We struggle to differentiate important findings from hyperbole and to understand how these new findings may influence our profession and our practices.

That we find ourselves with an abundance of opportunities and challenges emerging at a seemingly ever-quickening pace should be no surprise. We have created and funded the most sophisticated biomedical research infrastructure system the world has ever known. We

reward researchers who articulate innovative research ideas. There can be substantial financial rewards for those who bring new innovations to the marketplace, be they new pharmaceuticals, food products, or mousetraps. Marketing and advertising campaigns create a perception, rightly or wrongly, that new is inherently better, and we all want the best for ourselves and our patients. The speed at which information about new technologies can be accessed, by us and our patients, often leaves us playing catch-up, fearful that we may not know about a new finding that has important implications for our practice or defensive when our patients know more about a particular product or procedure than we might.



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In the following discussion, my intention is to identify some of the ways in which our evolving understandings of health and disease and the technologies that embody those understandings may impact clinical dental practice. It would be naïve of me to suggest that there is a single answer or that all dental practices will be impacted in the same ways; there are simply too many variables that will influence science transfer into clinical practice to suggest otherwise. What is useful, I believe, is a framework through which one might examine various components and the incentives motivating behaviors that ultimately determine the scope and degree of influence that new biologic-based applications will have on dental practice. Such a perspective is prescriptive rather than descriptive and seeks to answer the question: What should happen based on what we know now? This approach will not perfectly envision the future; it is hoped it will contribute to our perspectives on the challenges and opportunities that lie ahead.

### Responding to Change

Change is inevitable and omnipresent: in population demographics, in disease epidemiology, in our understanding of disease etiology, in dental education and the dental workforce, in patient expectations about what is appropriate and what is possible, in available resources, and in the content and volume of scientific publications (Formicola, 2002; Rose, 2002; Seldin and Brown, 2002; Tabak, 2002; Rose, 2002). New biologic-based technologies and clinical applications resulting from our investments in research present special challenges for us; the potential impact on dental practice may be profound and may force us to re-examine our fundamental notions and assumptions about our professional roles and responsibilities. Our responses—be they proactive or reactive—will be influenced by at least four factors that are the basis for the remainder of this paper: (1) our vision of what it means to be a professional, (2) the health consequences (or the benefits and risks) of the

new biologic-based interventions, (3) the infrastructure required to support the application and the process of care, and (4) the incentives that influence adoption and behavior change.

**Our Vision of What It Means to Be a Professional:** King Whitney, Jr.'s quotation offers a perspective on the future. How readily we resist, embrace, or engage in a change process—generated by us or imposed on us by others—may be one indicator of our shared vision of dentistry and of our role and responsibility as oral health professionals. As professionals, we share in our commitment to honor the trust and responsibility society has placed in us, to address

we voluntarily agree to abide by the American Dental Association's Principles of Ethics and Code of Professional Conduct (ADA, 2003). The principle of nonmaleficence or do no harm requires of us the obligation to keep knowledge and skills current and to know one's own knowledge and skill limitations. Before new interventions are widely adopted (and before more long-standing interventions are abandoned), we must verify the health consequences. In doing so, we create opportunities for the health effect of the intervention itself to guide us rather than anecdotal reports or captivating marketing campaigns. We are obliged to understand the health needs

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*The speed at which information about new technologies can be accessed, by us and our patients, often leaves us playing catch-up, fearful that we may not know about a new finding that has important implications for our practice or defensive when our patients know more about a particular product or procedure than we might.*

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the needs of those we serve, and to balance the conflicting financial incentives we face as professionals. We have competence in a specialized body of knowledge and skills and are stewards in advancing and passing on this knowledge to future generations. We have continually sought to serve the public's best interest in the ways in which we educate, organize, and govern ourselves; in the care we provide; and in the research and dissemination activities we support. In a rapidly changing environment, however, it is risky to conceive of our profession and our role as professionals by looking at what we have always done and believe that our duty and responsibility lie in maintaining the status quo; in times of change, our professional responsibility to do more has never been as critical.

**The Health Consequences Associated with the Technology:** As American Dental Association members,

within a population, to determine whether there exists an effective intervention to address those needs, and to weigh the benefits and risks of such approaches before a technology is widely disseminated into clinical practice (Figure 1) (Field et al., 2000). Higher-tiered activities are initiated once lower-tiered criteria are achieved. Without such a systematic approach, one may identify a technology in search of an application rather than a health need in search of an effective intervention. Our challenge and our opportunity to appropriately guide the development and application of new biologic-based technologies is to require evidence based on appropriate clinical studies that inform and education. To do otherwise is to violate the trust placed in us by the public.

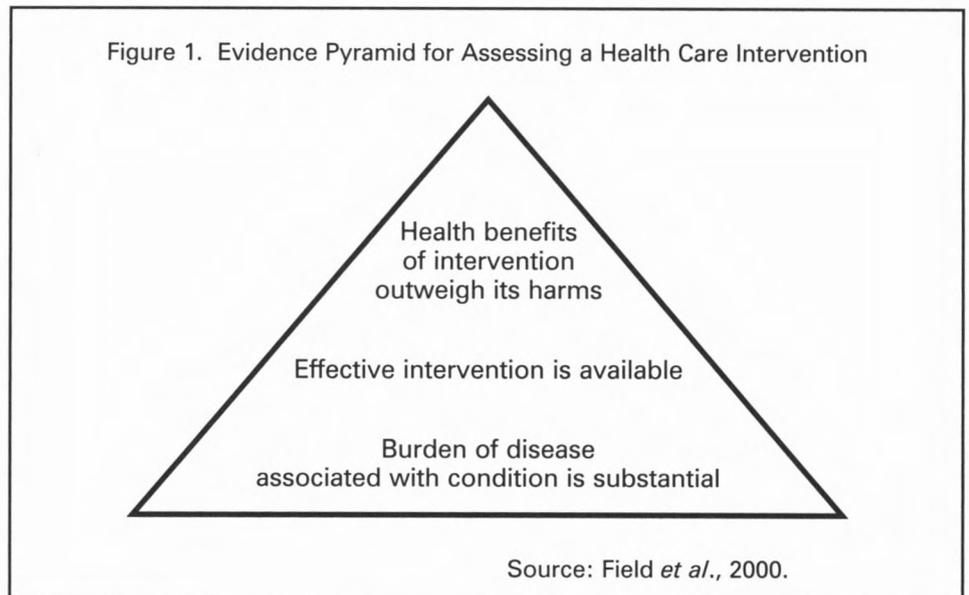
**Infrastructure and the Process of Care:** Dental practice must change to incorporate new scientific information. In isolation, the technologies that reflect

## Implications of the New Biology

these advances will not be nearly as significant a factor in altering the practice of dentistry as will be the way these technologies are integrated into a new way of doing business. The exact nature of this new business model is unclear; it is clear its development will be guided by infrastructure and process of care requirements based on new biologic approaches. These requirements have multiple dimensions (e.g., education and training, communication, equipment and supplies, facilities, financing, and reimbursement) and occur at multiple levels (e.g., within a dental operator, within an office or health care facility, between offices or facilities) from various perspectives (e.g., dental professional, the patient and his or her family, other health professionals, insurers, manufacturers, and society). And these requirements are likely to evolve with time, experience, and knowledge.

Infrastructure needs associated with new biologic-based applications will provide some sense of the opportunities and challenges that we face in applying these technologies in clinical practice. In three broad areas, they include the cost of acquiring and maintaining the technology itself, the cost (if any) of accommodating the technology within existing facilities, and the personnel with the expertise required to apply the technology. Cost will be a major factor guiding

Figure 1. Evidence Pyramid for Assessing a Health Care Intervention



challenge us to examine our notions about how we organize ourselves, where we practice, and what we do.

As general dentists and dental specialists, we rely on a body of knowledge and a degree of clinical expertise to manage the oral health of our patients. Our ability to incorporate new biologic-based applications into our practices will be determined, in part, by the availability of personnel with the requisite knowledge and skills. If integration of new biologic-based approaches can be achieved by relying on existing knowledge and skills, then the likelihood of

quently, integration will be delayed until the requisite knowledge and skills are obtained. In special situations, these requirements may necessitate new (or different) personnel. Those dental professionals who respond more quickly to these needs will integrate the new technologies more quickly.

Processes of care characterize what happens to patients when they are receiving care, be it in a dental office, medical office, hospital, or other health care facility. The ease of integrating new technologies into dental practices will be influenced by the flexibility and responsiveness of processes in adapting to change. For example, specific processes of care may vary. In theory, all of these processes are designed to maximize efficiency. If integration of new biologic-based approaches can be achieved seamlessly, then the likelihood of adoption increases. Some technology applications, however, may require significantly more collaboration and information exchange with other health professionals (e.g., physicians or pharmacists) or may necessitate a significant change in patient flow. If such applications require fundamental process changes, then integration will be more difficult and the speed of adoption will lag, at least in the short term. Those offices that can adapt more quickly to changing technologies may

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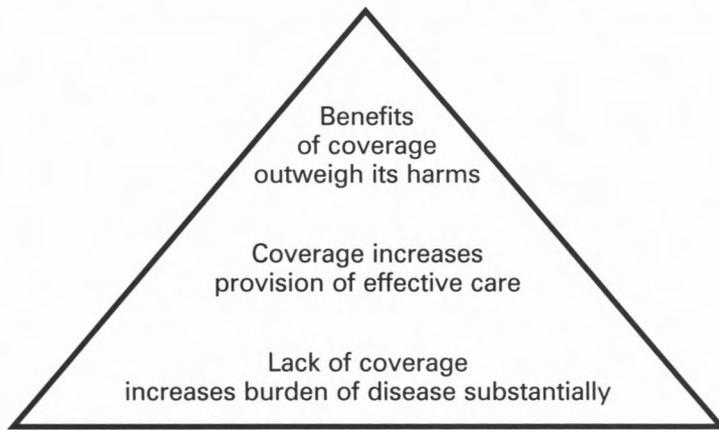
*In a rapidly changing environment, however, it is risky to conceive of our profession and our role as professionals by looking at what we have always done and believe that our duty and responsibility lie in maintaining the status quo; in times of change, our professional responsibility to do more has never been as critical.*

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adoption: the variability in cost is likely to be substantial, depending on the application. Some will require minimal investment, others will require partnerships, pooled resources, and outsourcing. Such requirements and the likelihood of achieving certain efficiencies will chal-

adoption increases. We may come to learn about new technologies and their application through professional journals and continuing education courses. In some cases, however, technology applications will require new knowledge and different clinical skills, and, conse-

Figure 2. Evidence Pyramid for Assessing a Coverage Policy



Source: Field *et al.*, 2000.

have significant advantages. Likewise, those offices that cannot adapt as quickly may miss opportunities to integrate rapidly new technologies into patient care processes.

**Incentives:** Some factors will encourage and others will discourage the adoption of new biologic-based applications. As health professionals and as patients, we respond to these positive and negative incentives in predictable ways: positive rewards result in more of a desired behavior, negative rewards result in less (Eisenberg, 1986). Incentives may be externally driven (e.g., reimbursement), internally derived (e.g., ability to tolerate uncertainty), or some combination of the two.

One incentive that clearly will have a role in adoption of new biologic-based approaches in dental practice is the outcome of coverage decisions by insurers and the level of reimbursement dentists may receive for the intervention (Figure 2). As noted earlier, this figure suggests a hierarchy whereby one would first determine whether lack of coverage increased the burden of disease substantially. If coverage increases the provision of effective care, then the procedure would be covered if the benefits of coverage outweighed its harms. Previous experience would support the assumption that new biologic-based approaches

will require more resources than existing interventions. They may offer more benefit as well.

Other examples of incentives include patient expectations and knowledge about the technology, opinion leaders and others who provide advice and views on the technology, malpractice costs that may increase depending on the level of risk associated with the procedure, prac-

tions, academic institutions and regulatory and politics entities, to name a few. While a discussion of the incentives faced by each for implementing a new biologic-based application is beyond the scope, it is worth noting that each entity will face set of incentives that are often in conflict with incentives faced by others with vested interests in a particular outcome. What may be perceived to be a positive incentive by one group may be perceived to be a negative incentive by another group with a different perspective. Additionally, the same incentive may be viewed positively or negatively by the same entity depending on its implementation.

## Conclusion

Our ethical obligation as dental professionals to honor society's trust in us to place our patients' needs above our own is clear. The consequent responsibilities to advance the specialized body of knowledge that defines our profession and to translate that knowledge into clinical practice have never been more complex. Don Berwick, MD, MPP, well-known for his work in improving the quality of medical care, reflected:

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*Infrastructure needs associated with new biologic-based applications will provide some sense of the opportunities and challenges that we face in applying these technologies in clinical practice.*

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tioner experience and education, the influence of other stakeholders who may employ advertising and product or technology detailing, and the perceived or actual likelihood that other professionals begin providing the same or similar services if we do not.

Implied in this incentive discussion is the perspective of dental professionals. As noted earlier, there are multiple other perspectives: the patient and his or her family, the third-party payer, the purchaser or employer, society at large, manufacturers and supplies, other health professionals and professional organiza-

To create a future different from its past, health care needs leaders who understand innovation and how it spreads, who respect the diversity in change itself, and who, drawing on the best of social science for guidance, can nurture innovation in all its rich and many costumes.

A challenge for us all will be to determine whether, relative to current practice, the added benefits associated with new biologic-based approaches are worth the required additional resources. In some cases, the new biologic-based intervention may yield better outcomes

Figure 3. Expanding Coverage to a New Intervention; Possible Outcomes

Health outcome of the intervention	Cost to third-party payer (and purchaser)		
	Lower	Same	Higher
Better	++	+	?
Same	+	?	-
Worse	?	-	--

Source: Field *et al.*, 2000.

at a lower cost (Figure 3, upper left). In other cases, the new biologic-based intervention may be both more expensive and less effective (lower right). Quite likely, however, most interventions will lie somewhere in between, requiring us to make decisions about tradeoffs given constrained resources.

Our opportunities are enormous, and our challenges are equally formidable. Our successes and shortcomings will be measured by the public and future generations by how well we guided this process and how clearly we remained focused on what was best for our patients. Not only it is our responsibility, it is the right thing to do.

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# In Search of the Secrets of Methuselah: Implications for Dentistry in the Third Millennium

Marc W. Heft, DMD, PhD

## Abstract

Aging is the progressive deterioration of bodily functions over time. Age has been prolonged as more individuals avoid early death and as the mature years are extended. The potential exists for even further extensions of age through genomic advances. Although it is currently unclear how this might happen, the benefits of research in genetics might extend oral health-related life issues through a multi-prong approach.

At the beginning of the new millennium the prospects for life extension have been tweaked by the establishment of the Methuselah Mouse Prize to promote research to extend the healthy human lifespan ([www.methuselahmouse.org](http://www.methuselahmouse.org)). While it is widely known that interventions such as caloric restriction in several species can substantively increase life span, this remarkable finding has failed to engage the interest and imagination of the public—perhaps because the required 25% reduction in caloric intake necessary to increase the *quantity* of life would likely put a cramp in one's *quality* of life! The intent of the prize is to expand the scope of focus of aging research beyond studies

that help understand the aging process to studies that will demonstrate the effectiveness of anti-aging interventions. More specifically, the promoters of the prize provide the following rationale:

Aging research is fashionable, but serious anti-aging research is not. We feel that a major reason for this is that the general public does not think that substantial human life-extension will occur in at least their or their children's lifetimes; hence it is effectively science fiction, having entertainment value but not being worth agitating for. This fatalism on the part of the public leads inevitably to lack of public funding for anti-aging work, and thence to lack of advocacy of anti-aging work by experts, which in turn serves to maintain public pessimism.

The intent of this contest is to provide rewards for novel and innovative interventions introduced in adult animals that either demonstrate a postponement of mortality in the mature animal or demonstrate a reversal of the aging changes and effects that have claimed the animal. The plausibility of longer-lived humans appears more reasonable in light of discoveries associated with studies of human centenarians (who in many instances live relatively disease-free to one hundred years of age

and older) as well as from the Human Genome Project that has identified genes and groups of genes that through interactions with the environment modulate health and disease. The prospects for life-extension raise questions about what factors influence the deterioration in functioning that are associated with aging and what factors, diseases and conditions are responsible for death. While the "prize-honoree" Old Testament patriarch Methuselah reportedly lived to the incomprehensible age of 969 years, it is provocative to ponder the impact of a more modest gain of say 50% in both life expectancy, the median age of survival (from 80 yrs to 120 yrs), and life span, the age of the longest lived survivor (from 120 yrs to 180 yrs). Further, how will the prospect of life-extension at hand influence future models of aging versus how we think of aging today?



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### What Do We Know About Aging?

Aging is the progressive deterioration of virtually all bodily functions with time (for reviews see references by Austad [1997] and Hayflick [1994]). This is not to say that all measures and indices change with age. Senescent changes manifest at the organ system, organ, endocrine, hormonal, cellular, and sub-cellular levels. The rates of these changes

Thus, there are instances where an eighty-year-old person may be better off physiologically than a sixty-year-old person; that is to say, more physically and cognitively active with less or no apparent systemic disease. As such, one of the more pressing challenges for aging research or gerontology is to develop measures that effectively monitor basic processes that underlie the aging processes and can predict the aging rate and, ultimately, the life span.

decreased protection from cancer, and an increased failure to differentiate "self" (resulting in increases in autoimmune disorders). These are all factors necessary for the maintenance of oral health and functioning throughout the lifespan.

With successful life-extension, the progressive deterioration of the biomarkers will slow down or protective mechanisms within the organism will need to resist the progression of the deterioration. Thus, for example, either the rates of oxidative damage or the accumulation of free radicals from oxidative stress or both must be diminished to prevent damage to DNA, proteins, and lipid constituents of cells. Further, the integrity of telomeres will need to be preserved to allow continued replication cycles and functioning of rapidly dividing cells, such as the lining mucosa or fibroblasts, in the human body. Finally, immune competence will need to be preserved well beyond the eighth decade to protect the host from the onslaught of infectious agents and cancer. Since the major dental diseases, dental caries and periodontal disease, are infectious diseases, maintenance of immune competence will likely be important for the prevention and control of these diseases as well as other viral and fungal infections and preservation of optimal oral health in older adults.

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### *No treatment or intervention to date has successfully delayed or reversed the aging process in humans.*

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vary greatly within individuals. Certain features are readily apparent and pervasive such as wrinkling of the skin, hair loss, and declines in lean body mass, for example. However, the severity and variability of presentation of these observable changes underscores the fact that what we think of as aging is actually an interplay among an underlying "biology of aging," diseases including age-related diseases and conditions (and the associated medications used in their treatment and management), and behavioral and environmentally-related factors. Thus, while skin wrinkling is related to the increase in cross-linking of collagen fibers with age, areas of skin that have been exposed to ultraviolet rays of sunlight demonstrate this to a greater degree. On the other hand, certain clinical measures such as the normal laboratory values for sodium and potassium electrolyte levels and hematocrit are age-invariant. Whenever changes are noted, they are usually associated with diseases and conditions.

Although chronological age provides a reasonable estimate of temporal changes in functioning and processes, it is a crude measure. There is great variability in the health, functioning, and well-being of older adults of a given age based on their genes, behaviors, and burden of systemic diseases (especially chronic diseases of aging including cardiovascular disease, cancer, and stroke).

Not surprisingly, the aging process is a complex phenomenon, and aging rates are not uniform across all systems. Thus, one may lose muscle strength at a different rate than hearing deteriorates. Several biomarker candidates, putative objective markers for the aging process, have been identified although they are difficult to measure. For example, at the cellular and subcellular levels, there is belief that telomeres (bits of DNA at the ends of chromosomes that shorten with successive replications) and oxidative damage to DNA, proteins, and lipids from free radicals may provide the basis for this level of understanding. An additional potential biomarker candidate

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### *The greatest likelihood for substantive gains in life extension will be through the ability to reconstitute impaired or injured tissues and cells and repair damaged DNA, proteins, and lipids.*

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that has shown promise serves to monitor immune function and competence. Since the immune system provides surveillance and eliminates foreign organisms (e.g., viruses and bacteria), tumor cells and substances, but, at the same time, recognizes, distinguishes and preserves "self" from the foreign substances. With immunosenescence comes decreased resistance to infectious diseases,

### How Will Life Extension Be Achieved?

Prolonged life extension results from three possibilities. Up to the present time, gains in life extension have been achieved in two ways. First, life expectancy has been increased by improving early survival rates, mainly by decreasing the infant mortality rates and, thereby, allowing more individuals to attain old age.

Early interventions and counseling of women during pregnancy have helped reduce the incidence of low birthweight infants with higher rates of mortality. Also, improvements in care for neonates have improved long term survival of this cohort. Second, life expectancy has been increased by improving late survival rates. This gain has been achieved through medical advances that have identified and successfully treated the chronic diseases of aging—cardiovascular diseases, cancer, and stroke—as well as acute infections. Yet, further improvements in life extension through treatment of the major chronic diseases is unlikely because, as Hayflick (1994) has reported, the elimination of the major cardiovascular diseases, stroke, and cancer would likely only increase life expectancy by fifteen years.

other factors such as injurious behaviors. So, a forty-year one pack-per-day smoker aged sixty-five years would likely show an accelerated decline in lung function due to the damage inflicted by smoking when compared with a non-smoker. Thus, the challenge of life extension in the most general sense will be to reconstitute impaired or damaged tissues to provide accruals in functional reserve to fight physiological challenges.

### What Do We Know About Oral and Dental Aging?

Findings from available oral health data indicate that older adults exhibit significant disparities in oral health that are amplified among subgroups that demonstrate disparities (e.g., racial and ethnic minorities and lower socioeconomic status individuals). Older adults

impact of their occurrence rather than active disease. Thus, although older adults demonstrate greater periodontal attachment loss than younger individuals, this does not mean that older adults suffer from greater active periodontal disease.

### What Are the Prospects for and Impact of Longer Life?

The greatest likelihood for substantive gains in life extension will be through the ability to reconstitute impaired or injured tissues and cells and repair damaged DNA, proteins, and lipids. However, the “life extension strategy” must be a multipronged effort that seeks to fight disease, repair damaged tissues, and fortify and bolster the compromised host more effectively than is done presently. The tools for this dramatic transformation in life extension have emerged from the Human Genome Project that has led directly to the publication of the sequence of the human genome and numerous other mammalian and microbial species.

In the search for longevity genes, investigators have sought to identify single gene homologs for genes in simpler organisms, such as the nematode *Caenorhabditis elegans* that provide resistance to stressors such as temperature, ultraviolet light, and free radicals (Finch and Tanzi, 2002). This property is analogous to bolstering functional reserve capacity. It is likely that the “anti-aging genes” will not be single genes but rather constellations of several genes. Simple organisms are studied because of the simpler genome and shorter lifespan that enables investigators to assess life extension strategies in a shorter time. Current approaches are seeking to identify: (1) single genes in multiple species that influence longevity in those species, (2) genes that are related to cellular maintenance and repair, and (3) genes that are responsible for susceptibility to age-related diseases. The next steps will also need to identify the functions of the encoded proteins (proteomics).

With the end of the descriptive phase of the Human Genome Project that has

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*There is a demographic imperative associated with the “graying of America.” There is a need to anticipate and address the healthcare needs of older adults and strive to help maintain independence, dignity, and quality of life.*

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The third area of possibility for increase of life extension offers the greatest challenge for the emergence of genomic medicine. No treatment or intervention to date has successfully delayed or reversed the aging process in humans. A cardinal feature of the aging process is a decline in functional reserve, that is, the extra capacity of the organism to respond to physiological challenges beyond what is necessary for day-to-day functioning. This becomes apparent during influenza outbreaks when mortality is greater for older adults than for younger individuals, and for full thickness burns of the skin where older adults fare less well than younger individuals after controlling for the amount of tissue afflicted. It is also important to emphasize that the rates in loss of functional reserve due to the aging process are not uniform across all tissues and organs and may be further affected by

have the highest rates of tooth loss and edentulousness, periodontal attachment loss, and head and neck cancers (U.S. Department of Health and Human Services, 2000). Although there have been modest improvements in the oral health of successive and more recent cohorts, older adults still suffer a disproportionate burden of oral and dental diseases.

The cause of dental disease is not the result of aging alone, but it reflects the elevated risk for oral health decrements caused by systemic diseases and also prescription and non-prescription drug use that may increase one’s susceptibility to oral and dental problems (for example, medications that cause xerostomia). One further comment on measures of oral health is warranted. Since dental caries and periodontal disease are chronic destructive diseases, their measures at any point in time reflect the cumulative

identified the genetic components, we have begun to assess the functions of the genes of multiple species (Baum et al, 2002; Guttmacher and Collins, 2002; Varmas, 2000). This exciting new phase of genomics and genomic medicine will provide opportunities to apply understanding of gene function to the treatment of systemic diseases and conditions.

### What Are the Challenges for Dentistry?

At the beginning of the third millennium, we are confronted with two major challenges. First, there is a demographic imperative associated with the "graying of America." There is a need to anticipate and address the healthcare needs of older adults and strive to help maintain independence, dignity, and quality of life. Second, there is the sense of excitement and anticipation for the endless possibilities associated with sequencing of the human genome. This breakthrough will provide insights and increased understanding on the underlying causes of infectious diseases and developmental disorders.

In uncovering the mysteries of the aging process, genomic medicine will provide opportunities to effectively repair damaged DNA, proteins, and lipids that may otherwise compromise the survival of the host. Major breakthroughs will occur in bolstering the immune system to maintain effective surveillance against infectious agents and tumors and maintain the ability to discriminate between foreign substances and "self," and thus, eliminate autoimmune diseases. Finally, regenerative medicine will provide new tools to restore the function of damaged tissue by growing new cells, tissues, and organs.

Dentistry is beginning to reap the

rewards of the "genomic transformation." Researchers have demonstrated that genetic material can be delivered to damaged tissues through viral and non-viral vectors to repair and regenerate bone and salivary glands (Baum et al, 2002). Further, the salivary glands were "reengineered" to express an antifungal protein to kill or manage oral *Candida* infections. In addition, investigators have developed an approach known as "replacement therapy" to reengineer *Streptococcus mutans* by deleting a gene

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***The next generation of dentists must be well-grounded in the emerging genetic science so that they can appreciate and apply the new technology to preserve and promote oral health.***

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encoding lactate dehydrogenase so that it cannot produce acids, and, thus, will not produce dental caries. Thus, genomic medicine is beginning to make its mark on dentistry!

For the future, dentistry will have new tools to fight the infectious diseases responsible for the major dental diseases. New genome-based therapies will render disease-causing bacteria and viruses harmless. Genomic medicine will provide strategies to bolster immune competence that will be maintained across an increasing lifespan. Regenerative medicine will offer the opportunity for biologically-based therapies that will restore function by regrowing damaged tissues.

The next generation of dentists must be well-grounded in the emerging genetic science so that they can appreciate and apply the new technology to preserve and promote oral health. We are at a critical period in time in dentistry,

dental education, and dental research. At a time of exciting scientific breakthrough that will transform the profession, we are experiencing a very limited pool of dental graduates embarking on academic careers. Without a replenishment of the pool of scientifically-knowledgeable clinicians, clinical scientists, and biological scientists to accelerate translation of research discovery from the lab bench to patient care, we will lose touch with our legacy.

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# The New Dental Biology— Threat or Opportunity?

Cherilyn G. Sheets, DDS, FACD

## Abstract

A clinician argues that the new biology is a threat or an opportunity depending on the perspective practitioners take. New approaches should be seen as extensions of the services dentists can provide patients rather than restrictions. Different parts of the new biology will become available in the office at different times, and will be implemented by general practitioners or specialists, depending on their character. Important innovations in diagnosis and prevention are emerging currently. New relationships with medicine will be forged rather than dentistry becoming part of medicine. Innovations in dental education and continuing education will accelerate the coming changes.

Looking to the past, present, and future reminds me of rapid and punctuated changes. Some of us embrace change as an opportunity for new experiences, knowledge, and advancement. Others of us fear change as if something wonderful will be lost or compromised. Does change represent an opportunity, or does it represent new problems to be solved? It is all a matter of perspective. Certainly the introduction of the "new biology" into dentistry has evoked some excitement as well as concerns amongst our colleagues. The "new biology" is, in fact, an evolving biology that will deepen our under-

standing of cellular responses and functions, including growth factors, osteogenic proteins, and other numerous factors (Chai, 2003; Slavkin, 2001b; 2002). Exciting new possibilities in treatment options and outcomes may become reality in a few years that are only dreams today, due to these discoveries (Genco, Scannapieco, and Slavkin, 2000; Slavkin, 1998; 2001a). However, some clinicians fear that the ultimate impact these new treatment modalities will have upon our profession may eliminate dentistry as we know it today.

As the new biological treatment modalities become integrated into the oral health care of the country, there are some practical questions to be addressed. What benefits will be realized by the typical patient? How will the profession be educated in the new biology? What is the time frame? What is the role of the generalist or the specialist? How will the dental profession interact with their medical colleagues in areas of overlapping care? Is this an opportunity or a threat for dentistry?

## Potential Benefits to the Patient

Dentistry has made some exciting advances over the last forty years. We have changed and evolved from a profession that was primarily disease oriented to a profession that aggressively pursues health promotion, risk assessment, preventive education, and therapeutic treatments. Advances have been made in

dental materials, dental equipment, dental bioengineering concepts, computerized diagnostic equipment/3D imaging, CAD/CAM, dental and oral facial implants, sophisticated magnification/illumination systems, integration of the systemic implications of dental disease, improved patient/office management systems, and numerous other areas impacting the daily practice of dentistry.

Additionally, multidisciplinary team approaches that provide more comprehensive reconstructive oral health care are becoming integrated into treatment plans by generalists and specialists alike. Patients are more receptive to comprehensive dental care due to educational efforts by the profession, the print media, and the entertainment industry, often as it relates to esthetic or cosmetic dentistry. As a profession, we are able to "turn the clock back" for patients with esthetic reconstructive treatments and provide an end product that frequently replicates nature. For many patients, this seems like magic. Since increasingly



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patients are educated consumers of health care "products," they often take an active role in determining final treatment options and timing of treatment sequences. We in dentistry are rated highly by the public we serve for our talents and our integrity.

Knowing that the "new biology" holds such potential for the oral health of the public, the question then becomes, how do we integrate this new treatment modality into the daily practice of dentistry? Additionally, how do we as a profession meet the challenge of

professional standing within the research universities nationwide. We need to short cut this traditional process in order to stay current with the rest of the medical/scientific community and secure our position in the research-based university system. Retaining dentistry's connection to the prominent research universities is critical to the continuance of dental professionalism—a victory that our predecessors fought so hard to achieve.

Dental faculties are rapidly retraining themselves to educate the current dental students in a format that prepares dentists to be lifelong learners, capable and prepared to constantly refine their knowledge and treatment techniques. In the process, faculties will upgrade their collective skills to state of the art clinical diagnosis, treatment planning, treatment execution, and preventive follow-up. A hoped for result will be a revitalization of the dental university academic system, and a re-establishment of dental schools as the educational hub and standard bearer for science-based, pre- and post-doctoral craniofacial-oral-dental education.

Advances in biological treatments must be mastered by clinicians as new techniques become available to the marketplace. Clinicians need to learn not only the biological techniques that are within their discipline or specialty, but

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*It could be exciting to have additional treatment options at our disposal that do not just replicate nature, but that reproduce or "mimic" nature.*

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And yet, we know that even with the beautiful porcelain, esthetic reconstructive periodontal plastic surgery, dental implants, and enamel mimicking dental materials, there are times when we feel inadequate to completely correct dental defects. It could be exciting to have additional treatment options at our disposal that do not just replicate nature, but that reproduce or "mimic" nature. It could be even more exciting to have treatment options that do not just correct oral diseases but prevent the diseases from ever occurring. To be able to reproduce from a patient's DNA a new perfectly matching central incisor could be a miracle for individuals who lost their own teeth. To be able to cultivate stem cells from an avulsed deciduous tooth to grow new osseous or soft tissues for an oral-facial traumatized patient could be a powerful treatment option. To be able to genetically predict the future of a patient's potential disease process, prior to the disease occurring, could allow a localized preventive strategy that could avoid the predictable oral breakdown. To be able to alter the gene that will make a patient vulnerable to oral disease could protect a patient's oral and systemic health. The possibilities and permutations that could positively impact the health and quality of life for our patients are endless. The Human Genome Project (HGP) has broken the genetic code that holds the secrets of biological solutions to many health problems, including cranio-facial-dental health.

acquiring the knowledge and skills necessary to align our treatment capabilities with the current capabilities of science? And lastly, who will meet this need if we don't?

### Professional Education and the Time Frame

Common wisdom says that it takes twenty to thirty years for a radical new advancement to be integrated into a profession. Twenty years allows time for the dental educational system to absorb concepts and techniques, integrating them into the pedagogy. Twenty years allows time to retrain the early and moderate adaptors. Twenty years allows for a large number of the resistant/late technology adaptors to retire from practice.

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*To be able to reproduce from a patient's DNA a new perfectly matching central incisor could be a miracle for individuals who lost their own teeth.*

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Twenty years is a long time in today's fast paced scientific world. Allowing twenty years to implement the changes or opportunities derived from the HGP will make us vulnerable to others providing the oral-facial responsibilities we are not prepared to handle. Perhaps even more significantly, anything short of rapid scholarly activity within our academic dental community and practicing clinical community to advance the new science of dentistry will jeopardize our

how to access the treatment options that are outside of their training or expertise. Therefore, leadership training for the clinical dentist in the formation and management of multidisciplinary teams is critical to optimizing patient outcomes. Hands-on, mentoring formats for continuing educational programs will expedite the retraining process. Universities have an opportunity to meet this need with creative planning of

their continuing education programs.

With the trend towards Problem Based Learning in the dental school curricula, many of the pieces are already in place that will foster future retraining of the current dental student population. Skills that allow a student to be successful with a PBL pedagogy will prepare them for a future professional life of retraining and lifelong learning. However, practicing dentists trained with a traditional pedagogy will need a systematic retraining program to integrate the new biological treatment options into their daily practice of dentistry. Through a coordinated effort of the academic community, the research community, organized dentistry, and clinical dentists, new biological treatments could dramatically shortcut the "traditional twenty year" integration time period, so that beginning technologies could be integrated in as few as five years.

### Role of the Generalist or the Specialist

Referring to the "new biology" as a singular entity to be absorbed as a whole, is overly simplistic. Some biotechnology will be quickly integrated into the profession and potentially mastered by anyone with a dental degree, such as saliva testing for oral diseases. Periodontal disease testing, immunization against oral diseases, and other diagnostic/therapeutic procedures will be appropriate for use in dentistry and should be integrated as available. Other biological treatments applicable to clinical practice will require more intensive training.

Some biological treatments will fall naturally in each of the disciplines of dentistry. For example, restorative oriented biotechnology should provide needed treatment options to general dentistry and prosthodontics. Oral maxillofacial surgery and periodontics will benefit greatly from biological answers to stimulating bone growth, reconstructing lost hard and soft tissues from genetic information, and other innovative practical uses. Dental hygienists may be more involved with sealants,

cavity varnishes, immunizations, bio-film control, community outreach of preventive therapies, and other appropriate endeavors. Orthodontists and pediatric dentists may be able to genetically alter oral facial growth defects, minimizing or eliminating gross malocclusions and associated maladies. Oral pathologists may be able to prevent or mitigate life-threatening diseases.

The role of the biologically trained specialist for each discipline of dentistry is an exciting future prospect. As each specialty examines the new biological science for applications to their area of dentistry, the public will benefit from future clinicians' broadened capabilities and knowledge. Dentistry must be self-sufficient as a profession, drawing upon the dental research community to sys-

tematically and rapidly close the gap between research and clinical applications. The new multidisciplinary team approach to care factors in a close working relationship between researchers and clinicians. The traditional wall between clinical dentistry and research must be torn down.

From a pragmatic standpoint, traditional dentistry will be performed for decades to come. Current craniofacial-oral-dental disease will need to be treated and health maintained. New discoveries and advances in more traditional treatment protocols will occur, even as the newer biological based treatments are developed. It is therefore predictable that a natural transition should occur from current practice patterns to new biologically based treatment protocols of the future.

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*Twenty years is a long time in today's fast paced scientific world. Allowing twenty years to implement the changes or opportunities derived from the HGP will make us vulnerable to others providing the oral-facial responsibilities we are not prepared to handle.*

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tematically and rapidly close the gap between research and clinical applications. The new multidisciplinary team approach to care factors in a close working relationship between researchers and clinicians. The traditional wall between clinical dentistry and research must be torn down.

From a pragmatic standpoint, traditional dentistry will be performed for decades to come. Current craniofacial-oral-dental disease will need to be treated and health maintained. New discoveries and advances in more traditional treatment protocols will occur, even as the newer biological based treatments are developed. It is therefore predictable that a natural transition should occur from current practice patterns to new biologically based treatment protocols of the future.

### The Dental-Medical Interface

If as a profession we embrace the new

prototype will be established through the use of gene modification, stem cell research, and other biological modalities. Dentistry must be prepared for addressing the need in a thoughtful, responsible, and scientifically precise manner. We must forge a close working relationship with the various medical areas of clinical care and research as oral biologists share knowledge with their medical counterparts. A creative and proactive approach by dentistry is needed at this critical time to not vacate our rightful place as the oral specialist of the health care community (Kuhn, 1962).

### Opportunity for Dentistry

The HGP and all of the associated scientific discoveries represent a tremendous opportunity for dentistry. Sixty years ago, our predecessors could have never imagined dentistry today. They would not believe the modern dental offices, the attention paid to infection control,

the inclusion of technology from computers/lasers/microscopes/digital cameras, the improvements in handpiece designs, the extensiveness of dental treatments, the importance of esthetic dentistry, the ability to place dental implants to restore a lost dentition, and all of the various treatments we render daily. More than likely a large percentage of the dental profession of that era would have thought that some of these future changes were threatening and would have opposed them. We do not want to be guilty of the same lack of vision. Instead, we want to embrace the new discoveries, plan for their inclusion into daily clinical practice, and expand our capabilities as we care for patients. As the Surgeon General's Oral Health Report disclosed, one third of our U.S. population has deplorable oral health. Preventing some of the disease through biological approaches will more rapidly bring us to a containment of the access to care problem.

### Summary

For each of us, some or most of the knowledge that we learned in dental school is obsolete. Science and technology have and continue to change the profession of dentistry. However, the one concept that we learned in dental school that will never become obsolete is the importance of striving for excellence. Let us continue to strive for excellence in our clinical care of patients, morphing our skills to reflect the best of the current science that is available. It is exciting to know that in the near future it will be possible to reproduce nature, rather than replicate nature, to solve patients' craniofacial-oral-dental needs.

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# National Institute for Dental and Craniofacial Research

## *Strategic Plan—2003-2008*

### **Mission**

The mission of the National Institute of Dental and Craniofacial Research is to improve oral, dental and craniofacial health through research, research training, and the dissemination of health information. We accomplish our mission by:

- Performing and supporting basic and clinical research;
- Conducting and funding research training and career development programs to ensure an adequate number of talented, well-prepared and diverse investigators;
- Coordinating and assisting relevant research and research-related activities among all sectors of the research community;
- Promoting the timely transfer of knowledge gained from research and its implications for health to the public, health professionals, researchers, and policy-makers.

### **Core Values**

In our efforts to improve the oral, dental and craniofacial health of the public, we will prioritize scientific opportunities on the basis of their potential impact to improve health, the readiness of the scientific community to accomplish them, and their alignment with the following core values:

**SCIENCE:** Our programs and activities to support research, research training, and information dissemination will be driven by science.

**TRUST:** Our resources and programs will be managed, conducted, and evaluated in a manner that upholds the trust placed in us by the public.

**SOCIETY:** Our programs and actions will aim to improve the oral health of all people and eliminate health disparities.

### **Vision**

We will advance the oral health of all people and support the most rigorous level of science to meet the challenges of a changing society and promote the well-being of the Nation.

### **Overview**

In 1997 the National Institute of Dental and Craniofacial Research (NIDCR) unveiled its Strategic Plan, *Shaping the Future*. The driving forces behind our initial plan and this updated version remain the same—to adopt needed change, to identify and prioritize new opportunities for research, and to respond to the needs of the people we serve. In the same way that we initiated *Shaping the Future*, we embarked on updating the Strategic Plan mindful of the remarkable pace of continuing biological discoveries, and aware that we must do all we can to keep up the momentum, encourage young people in the pursuit of science, transform health professional education, and ensure that oral health research can benefit all people.

Our commitment to respond to the changing needs of the public is evident

when we consider how the NIDCR has evolved. Created in 1948 as the third component of the NIH, the NIDCR was first named the National Institute of Dental Research. The driving force that launched the new Institute was concern over the nation's military readiness; far too many otherwise healthy young recruits were rejected for service during War World II because they lacked six opposing teeth. More than 50 years later, tooth loss of this magnitude is rare among young people in the U.S. and remarkably lower overall. Yet much work remains to be done to eliminate oral diseases that keep people from being fully healthy. Today the pressing needs include understanding the complex genetic, environmental, nutritional, and behavioral factors that result in oral diseases and conditions; addressing the persistent disparities in health status; and carrying out the health promotion and outreach efforts needed to improve health.

This Strategic Plan addresses the myriad diseases and conditions that affect the oral cavity and craniofacial structures by outlining a course for the Institute to follow in the areas of research, research training, and communication of research results. Recognizing the need to focus our efforts in areas that offer extraordinary scientific promise, the goals and objectives of this plan are centered on:

- Advances from clinical and population-based research that are identifying risk factors and markers for the

progression of disease and are stimulating new preventive, diagnostic, and treatment approaches to oral, dental and craniofacial diseases and disorders;

- New knowledge from the Human Genome Project that is leading to novel ways to prevent, diagnose, and manage oral, dental, and craniofacial diseases and conditions;
- Revolutionary advances in cell and molecular biology and in bioengineering that are enabling the growth, repair and regeneration of tissues damaged by disease, injury or malformations; and
- New knowledge from health communications research that is being used to promote healthy behaviors, improve oral health literacy and enhance the adoption of research into practice.

These and other emerging research advances are changing how oral health research is conducted. More than ever, research is not defined or confined by the boundaries of a single scientific area but is increasingly characterized by an eclectic mix of disciplines. Computer scientists, mathematicians and biologists together have formed the new discipline of bioinformatics—the use of mathematics, statistics and computing to model biological processes and ultimately solve biological problems. Biologists, engineers and clinicians are working together to fabricate living parts for the body from cells in the laboratory, creating the new field of tissue engineering. Protein biochemists have teamed with engineers to create “labs on a chip,” small enough to begin to pursue simultaneous monitoring of multiple substances in real time. The interplay among environmental, behavioral, nutritional, and genetic factors that underlie human health and disease has led to the creation of unique multi- and inter-disciplinary research teams. Recognizing this crucial need to ensure a diverse and adequately trained research workforce, the plan sets forth an aggressive agenda to enhance multidisciplinary career training and development.

As research progress increases, so does our responsibility to ensure that scientific knowledge is communicated clearly and effectively to all who need it. Thus, NIDCR recognizes the need to increase efforts to translate research findings into tangible results that will improve clinical care and to communicate science-based information to health professionals, professional organizations, and the public.

Improving the nation's oral health is an ambitious goal, and NIDCR recognizes the importance of partnerships in achieving that goal. We also recognize the need to bring new partners to the oral health research enterprise from the broader scientific community, academia, the health professions, health voluntary organizations, industry and government. The creation of multidisciplinary research teams will require that we recruit new scientific disciplines to the field. Expanding the opportunities for research training and career development will require that we work closely with medical, graduate, public health and engineering schools as well as dental schools and dental and medical professional organizations. Enhancing our partnerships with both public and private sector organizations is equally important to realize our goal of promoting the timely transfer of knowledge and its implications for health to all audiences.

Our mission has remained the same since the day the Institute was created 55 years ago. We've come a long way, in terms of both scientific advances and improvements in the Nation's oral health. To achieve our ultimate goal, we must take advantage of new scientific knowledge and tools, strengthen and expand partnerships, ensure that research advances are translated into useful technologies, and above all make sure that our scientific efforts benefit people.

### Employing Powerful Tools

The completion of the draft of the human genome sequence in 2001 was heralded as one of the most important scientific milestones of all time.

Understanding how the 40,000 or so human genes function and how they interact with one another is a major challenge to be overcome to translate genetic knowledge into improved health. Ultimately, it is not only the genes that must be understood, but how they instruct cells to produce proteins, how and where these proteins function normally and interact with one another, and how faulty proteins or protein complexes can lead to disease. To date, the genome sequences of numerous oral microbes are being deciphered and major ones implicated in caries and periodontal diseases have been completed. But how is genomics—the analysis of the entire genetic makeup of a species—adding to our understanding of oral diseases? How is proteomics, or the study of the tens of thousands of proteins expressed by a cell type, changing oral health research? And how will the availability of genetic information and powerful technologies to analyze it change the way dentistry is practiced and help to improve the public's oral health?

Using genomic and proteomic approaches, researchers are unraveling the mysteries of how oral bacterial cells attach to a surface and become established in a “biofilm”, which oral health researchers and practitioners know as dental plaque. Such knowledge provides a brand new set of tactics for disease prevention. We can envision dental health professionals in the near future using a therapeutic substance to block or weaken the function of cell enzymes that enable caries-causing bacteria to anchor to enamel and form biofilm. Alternatively, they might apply products to render certain oral bacteria harmless by lessening their virulence, or they may give their patients products that short circuit communication among bacteria and host cells. Proteomic discovery of the patterns of salivary expression will lead to early identification of individuals most at risk of oral diseases as well as systemic conditions and diseases. These potential tools would not be possible without the knowledge gained from sequencing of human and oral microbial

genomes, and from proteomic studies that reveal how changes in human and microbial protein expression contribute to normal and abnormal function.

In the struggle against oral and pharyngeal cancer, we can foresee a new way of diagnosing and treating disease by using molecular techniques to help identify which lesions are likely to undergo malignant conversion. Earlier detection might be afforded by finding a “signature” pattern of substances in oral fluids—ranging from alterations in salivary proteins to abnormalities detected in the DNA of pre-cancerous cheek cells. Before long, surgeons could be using molecular markers to identify genetically abnormal cells at the margin of a tumor whose removal would reduce the chance of its recurrence. Using molecular information, clinicians may be able to tailor a patient’s treatment to deal with the specific molecular defects that caused the malignancy.

A genetic test to predict a person’s response to a particular drug—a far-fetched idea less than a decade ago—is now being used to identify patients who metabolize certain drugs poorly. This emerging field of pharmacogenetics offers great promise for improving drug effectiveness, preventing severe adverse drug reactions, and improving patient compliance. Pharmacogenetics will also benefit dental research. Genetic screening may improve drug development and testing by identifying and eliminating the number of participants in clinical trials who will not respond to, or may be harmed by a new drug being tested, thereby making clinical trials smaller, faster and less costly.

Genomics and proteomics are powerful tools that will revolutionize the practice of dentistry and the public’s perception of oral health care. We can now anticipate a day when no patient will experience pain, loss of function, or disfigurement from late-stage oral diseases. Instead, they will be treated by oral health professionals who use drugs instead of drills, regenerate damaged oral and craniofacial tissues, identify problems before they manifest clinically,

and stop or reverse disease instead of practicing damage control.

### Benefiting from Our Investments

The NIDCR is uniquely positioned to remain a key player in genomics, proteomics, and the growing field of tissue engineering. For more than four decades, dental researchers have studied the basic biological, chemical, and molecular structure of bone and have worked to identify proteins that stimulate bone growth and repair. The NIDCR was a pioneer in the study of the chemical properties and molecular structure of collagen, which is an integral part of bones, teeth, and the periodontium—the connective tissues surrounding the teeth. The Institute’s world-class research program in matrix and developmental biology has led to a basic understanding of how cells organize to form the hard and soft tissues of the craniofacial complex. This basic knowledge is pivotal to the new discipline of bioengineering because it provides the key three elements needed for its success: (1) the scaffold or matrices on which to grow tissues such as collagen or bone mineral; (2) the cells to form cartilage, collagen, or bone; and (3) the biologic molecules (e.g., growth factors from bone matrix) that signal the cells to differentiate into specific tissue types.

The orofacial tissues pose particularly interesting challenges to tissue engineering research because of their complex nerve supply, finely-tuned muscle function, unique organs, multiple cell types that must be integrated with one another, and the ubiquitous presence of millions of microorganisms that influence tissue response. Information emerging from the human genome project, advances in our understanding of cell adhesion, and the availability of human adult and embryonic stem cells provide a wealth of potential approaches to designing bioinspired materials that can be used to engineer tissues (biomimetics). Researchers have discovered that third molars, which are often extracted and discarded, contain adult stem cells

that when cultured and expanded are capable of producing dentin in animal models. This and other approaches to regenerate dentin and other dental tissues may transform the way endodontic, or root canal therapy is performed.

Tissue engineering research has enormous potential to change clinical practice in other ways too. Someday it may be possible to use biomimetics to repair periodontal tissues, fill in bony defects caused by disease, craniofacial disorders or injuries, and regenerate muscle, nerves and salivary glands. Using remarkable biomimetic approaches, scientists are developing the first artificial salivary gland, a giant scientific leap that would benefit millions of Americans with salivary gland disease or dysfunction.

### Contributing to Other Disciplines

Unlike the internal organs of the body, the structures of the mouth are readily visible and accessible. This unique feature has allowed using the oral cavity as a model to understand systems or diseases that occur elsewhere in the body. Only recently have scientists begun to appreciate the potential of the oral cavity to be used as a “real time” laboratory using the tools emerging from molecular and cell biology. Viewed from this perspective, it will be possible in the not-so-distant future to test, observe, measure, and understand complex processes that affect the entire human body by examining the cells, proteins, and molecules from tissues and fluids in the mouth.

Scientists have long recognized that our saliva serves as a “mirror” of the body’s health in that it contains the full repertoire of proteins, hormones, antibodies, and other substances that are frequently measured in standard blood tests. The Institute’s work currently includes a major research effort to identify and address major cross-cutting biomedical challenges, and will further develop needed technologies and create the first comprehensive baseline catalogue of all proteins found in oral fluids of healthy individuals. The NIDCR envisions that this

basic research could one day translate into miniature, hi-tech tests, or so called "labs" on a silicon chip, that rapidly scan oral fluid for the presence or absence of multiple proteins linked to various systemic diseases and conditions. Ultimately, this approach could be used for real-time health surveillance—rapidly identifying persons most at risk at the earliest moments of detectable change in key diagnostic markers.

Oral health researchers have taken advantage of the easy access to oral tissues to make significant contributions to other scientific areas as well, such as immunology, neurobiology, and pain research. The NIDCR's seminal work in microbiology and immunology opened new insights into the nature of the inflammatory process and defined cytokines—hormone-like factors—that participate in the body's inflammatory and immune responses. Institute studies added to the knowledge about many conditions including Sjögren's syndrome, cleft lip and palate, ectodermal dysplasia, cancer, chronic pain and other neurological disorders, and many infectious diseases including candidiasis, herpes, hepatitis, human papillomavirus infection and acquired immune deficiency syndrome (AIDS).

The Institute's research efforts have not only improved the oral health of the nation, but also contributed important knowledge to understand and control systemic diseases. We remain committed to supporting research that has far-reaching implications for improving the health and well-being of people today as well as in the years to come.

### Sustaining Our Uniqueness

To achieve our vision of advancing the oral health of all people, we must strike a fine balance between attracting researchers from other related disciplines, and maintaining a critical number of investigators with intimate knowledge of the uniqueness of the orofacial structures and the diseases that affect them. The NIDCR has a rich tradition of working across diverse fields of basic science. These inter-disciplinary collabora-

tions have resulted not only in generating new knowledge, but also in improving clinical care. Further improvements in the oral health of individuals and communities will require a strengthened link among basic, translational and clinical research. (Clinical research is defined in this document consistent with the NIH "Nathan Report" to include patient-oriented research, epidemiological and behavioral studies, and outcomes research and health services research. See [www.nih.gov/news/crp/97report/](http://www.nih.gov/news/crp/97report/).)

Clinical research has been described as "the 'neck of the scientific bottle' through which all scientific developments in biomedicine must flow before they can be of real-world benefit to the public" (Association of American Medical Colleges, American Medical Association, 1990). Thus, enhancing the clinical research infrastructure, expanding the capacity and skills of future clinical researchers, and maintaining their link with basic researchers are critical to sustain and exceed the achievements of more than fifty-years of public investment in oral health research.

Findings from oral health research have led to the development of many successful approaches to prevent, diagnose, and manage oral, dental and craniofacial diseases. Indeed, NIDCR-supported research has led to the widespread adoption of water fluoridation and other measures to prevent tooth decay. These preventive efforts are estimated to have saved nearly \$40 billion from 1979 to 1989, and continue to save money and improve the quality of life for millions of Americans (Brown et al, 1994). Combining the tools of molecular and cellular biology, bioimaging, genetics, genomics, proteomics, engineering, epidemiology, social, behavioral science and clinical research will bring immense benefit to the millions of people affected by oral, dental and craniofacial diseases.

### Facing the Challenges

**Addressing Multiple Complex Diseases:** The mouth is a complex and unique environment. It contains exquis-

itely sensitive tissues that are used for taste, chewing, swallowing, speech, facial expression and fighting off diseases. It has one of the highest concentrations of sensory and motor nerves in the body, four different types of calcified tissue, and contains nearly 500 species of microbes (only about half of which have been cultivated thus far) that maintain a delicate balance between health and disease. Not surprisingly, there are a multitude of diseases and conditions that affect the oral cavity and related dental and craniofacial structures, including the teeth, soft tissues, salivary glands, the temporomandibular joint, jaws, and facial bones, muscles and nerves. Our challenges extend from the continued struggle against two of the most common infectious diseases—dental caries and periodontal diseases—to eliminating life-threatening oral and pharyngeal malignancies, craniofacial birth defects and developmental disorders, acute and chronic orofacial pain and other conditions that compromise oral health. We must not only understand the factors that increase the risk for and contribute to oral diseases, but also find the causes of oral diseases, seek new ways to improve quality of life for persons who suffer from them, and at the same time be prepared to face the unforeseen challenges that lie ahead.

**Attracting Researchers with Required Competencies:** With the remarkable advances in science and technology have come increased responsibilities to assure an adequate and diverse supply of highly competent investigators in the years to come. A variety of flexible and innovative research training and career development programs are needed to recruit and retain researchers with the right mix of skills. Specifically, future researchers will need to be familiar with a broad range of scientific areas, manage complex studies, and learn to create and work successfully in teams and with individuals from new disciplines. Specific competencies that will be required include knowledge of cellular and molecular biology, human genetics, human nutrition, structural biology,

molecular epidemiology, bioengineering, computational biology, behavioral and social sciences, and informatics among others. In addition, there is a critical need for researchers who are rigorously trained in the design and conduct of clinical trials and clinical research. Research aimed at eliminating oral health disparities will require investigators who can integrate knowledge from diverse fields and perspectives including biology, behavioral research, psychology, sociology, health economics, and health services research. The 1997 NIDCR Blue Ribbon Panel on Research Training and Career Development ([www.nidr.nih.gov/research/blueribbon/summary.pdf](http://www.nidr.nih.gov/research/blueribbon/summary.pdf)) emphasized the need to diversify the NIDCR research and training portfolio, expand the mix of disciplines in oral, dental and craniofacial research and adopt new strategies to promote diversity in the scientific workforce. Many challenges remain ahead to realize the full potential of the scientific opportunities that are unfolding before us today.

**Adopting and Applying New Technologies:** Against the backdrop of the extraordinary developments in biomedical science, there is a pressing need to ensure that tools emanating from new technologies are adopted and used. This is no easy task. It has been estimated that on average, it takes approximately twenty years for a new technology to be fully adopted and implemented into the health care system. Efforts will have to be devoted to increasing the awareness of NIDCR research results among providers, policy makers and the public and to enhance the Institute's capacity to translate research results into practice. Promoting technology transfer as well as the integration of oral health-related research findings into both the undergraduate and postgraduate curricula in academic health science centers will be important to ensure that the clinicians, researchers and educators of the future can fully apply science to benefit the public.

**Closing the Knowledge Gap:** Many oral diseases and conditions can be prevented and controlled; yet significant

gaps exist in the public's oral health knowledge, attitudes and behaviors. For instance, only 62% of U.S. adults recognize that the primary purpose of water fluoridation is to prevent dental caries; less than one-quarter of U.S. adults know that dental sealants prevent dental decay. Overall, U.S. adults are ill informed about signs and symptoms and risk factors for oral cancers—only 25% of adults can identify even one sign of this disease. The dental knowledge gap, while greater among individuals with lower educational attainment, also exists among racial and ethnic groups and is as prevalent among persons who make frequent dental/medical visits as it is among those who do not. Ensuring that target audiences become informed, make appropriate decisions about their health, and adopt behaviors that will improve their oral health, requires further advancement of our tools to communicate with audiences effectively. We also must enhance the public's access to and use of the most current science-based health information.

### The Burden of Oral Diseases

Oral diseases affect the most basic human needs: the ability to eat and drink, swallow, maintain proper nutrition, smile, and communicate. Oral health and overall health and well-being are inextricably connected. Many systemic conditions such as human immunodeficiency virus (HIV)/AIDS, diabetes, Sjögren's syndrome, and osteoporosis have important oral symptoms, manifestations or complications. The lips, tongue, gingivae (gums), oral mucosa and salivary glands can all signal clinical disease elsewhere in the body. Long considered to be localized infections only, periodontal or gum diseases are now being investigated as potential risk factors for the development of systemic disease. For instance, accumulating evidence now points to a possible link between periodontal diseases and the incidence of premature, low-birth weight babies, cardiovascular disease, and pulmonary disease. Oral diseases affect not only the health of the oral cav-

ity and associated craniofacial structures, but can be detrimental to the overall health and well-being of individuals.

In the section that follows, we highlight selected oral diseases, disorders, birth defects and conditions that are uniquely within NIDCR's mission to improve the oral health of the nation.

**Health Disparities:** The substantial gains in the oral health of the nation over the past generation have not benefited all Americans equally. The burden of oral and dental disease, particularly untreated disease, falls heaviest on individuals from lower socioeconomic groups, which include disproportionately large numbers of racial and ethnic minorities. Individuals in lower socioeconomic status groups also have higher incidences of HIV infection and diabetes, diseases that increase the risk for serious oral, viral, bacterial and fungal infections. Children in low-income families are particularly vulnerable to oral health problems. Their nutrition may be poor, their oral hygiene inadequate, and their access to oral health care lacking. A partial remedy for addressing health disparities lies in improving access to effective and appropriate health promotion, preventive, diagnostic, and treatment services. The research challenges to reducing health disparities include elucidating risk factors, identifying and eliminating barriers to health care, designing better means of care delivery, and designing educational strategies to reduce risk and enhance health promotion that are appropriate to the social and cultural frameworks of the groups in question.

**Dental Caries:** Dental caries—also known as tooth decay—is not extinct. Despite tremendous declines in the past three decades, tooth decay, the end result of a bacterial infection, remains the single most common chronic disease of childhood in the U.S. A troubling trend that partly explains the continued prevalence of caries is the increasing polarization of oral health in the U.S.—while most children enjoy excellent oral health, about 25% of children five to seventeen years of experience 80% of all dental caries in their permanent teeth.

Dental caries begins early in life: 18% of preschoolers in the U.S. have already experienced tooth decay and by age six to eight, more than half have experienced this disease—making it five to eight times more common than asthma. By age seventeen, more than 80% of the adolescent population is affected by caries. Dental caries is also a problem among adults; recurrent caries and root caries are prevalent among adults and the elderly. The subset of the general population most prone to caries is also the most vulnerable: the poor, the very young and the elderly, and those with compromising medical conditions or disabilities. Continued research to identify the most effective health education messages for the prevention of caries, particularly among underserved populations, is needed. New approaches to diagnose, manage and prevent caries throughout the lifespan may come from further research to understand the molecular consequences of the interaction between host and microbes, and from deciphering the genomic makeup of bacteria implicated in dental caries.

**Periodontal Diseases:** Periodontal diseases are a result of infections caused by bacteria in the biofilm that forms on the teeth in the cul de sac between the tooth and gum (gingiva). They include a range of clinical variants—from mild forms such as gingivitis to severe disease that can destroy the periodontal ligament and surrounding bone, in some cases leading to the loss of teeth. Almost half of U.S. adults ages thirty-five to forty-four have gingivitis, a reversible inflammation of the gingivae, and about one-fourth have the more severe condition of periodontitis. Severe periodontal disease affects 14% of adults ages forty-five to fifty-four, and 23% of sixty-five to seventy-four-year olds. Tobacco use is a major risk factor for the development and progression of periodontal diseases. There also is considerable evidence that diabetes, particularly if poorly controlled, increases the risk for periodontal disease. At present, treatment of periodontal diseases includes surgical as well as non-surgical approaches. Substantial

advances in our understanding of how cells adhere to one another and increased knowledge about the molecules that support and regulate nearly all cells are giving clinicians potential new options to manage periodontal diseases through the regeneration of tissues.

**Tooth Retention and Edentulism:** Vast improvements in tooth retention have taken place in the U.S. over the past three decades. Total tooth loss or total edentulism, once a relatively common condition among middle age adults is now most prevalent in older persons, affecting approximately one-third of adults sixty-five years and older. There is evidence that people with impaired dentitions due to missing teeth must choose foods that do not provide optimal nutrition; in the elderly, total edentulism and poor oral health can lead to significant weight loss that can affect overall health. The presence of twenty-one or more natural teeth has been used worldwide as an indicator of functional ability. Yet in the U.S. 58% of people fifty years or older and over one-quarter of the population over nineteen years of age do not have twenty-one or more natural teeth. Low-income individuals, and in particular low-income white adults, are most likely to be totally edentulous. The standard treatment for tooth loss involves prosthetic devices such as full or partial dentures. Although these devices initially restore some of the ability to chew, as people age and lose underlying bone, the fit and aesthetics of dental prostheses are often compromised. Replacement of teeth with dental implants provides more natural and stable function than do dentures, but not every patient is an ideal candidate for implants. While continuing efforts to prevent tooth loss, there is a need to evaluate the appropriate replacement of tooth function, and to pursue evolving technologies that are enabling the development of biologic materials to repair and eventually regenerate teeth.

**Oral and Pharyngeal Cancer:** Oral and pharyngeal cancer is the sixth most common cancer in the developed world. Each year, an estimated 28,900 Americans are diagnosed with this dis-

ease and more than 7,400 die each year from it (Ries et al, 2002). The most disturbing aspect about oral and pharyngeal cancer is the survival rate. In the U.S. the five-year survival rate is approximately 50%, a statistic that has not improved over the past twenty years. African American men suffer the highest incidence of these cancers and have a much poorer five-year survival rate than do white men regardless of diagnostic stage. Despite the devastating consequences of oral cancer, which include impaired ability to chew, swallow, and speak, and often disfigurement from extensive surgery to remove parts of the face and oral structures, only 14% of U.S. adults report receiving oral cancer exams that can detect early disease. Reconstruction and management of the oral cancer survivor come at a high price both economically and socially. Not only are more efforts needed to increase public and professional knowledge about oral cancer and its prevention, there also is a critical need to develop biomarkers and diagnostic tests that can be used to improve cancer diagnosis and more accurately predict the course of the disease. There also is a pressing need to develop more effective, individualized treatments that spare healthy tissues and improve quality of life.

**Pain and Chronic/ Disabling Conditions:** International epidemiologic studies indicate that orofacial pain occurs in approximately 10% of the adult population. Orofacial pain, by itself or as a symptom of an untreated oral problem, is often a major cause of poor quality of life. Toothaches alone are associated with significant morbidity and high economic cost. Sources of orofacial pain include caries, periodontal diseases, and neuropathic and musculoskeletal conditions. Orofacial pain also is a major symptom of temporomandibular muscle and joint disorders (TMJD) that are estimated to affect ten million people in the United States. Orofacial pain may also be caused by conditions involving the dental pulp (the innermost part of a tooth that contains blood vessels and nerves) and the

area around the root, leading to symptoms that can range from sensitivity to thermal changes to severe pain and/or abscesses. Today, pain researchers know that chronic pain can become a disease in itself, causing long-term detrimental changes in the nervous system. These changes may affect resistance to other diseases, as well as effectively destroy quality of life. There is considerable need for research that integrates knowledge gained from cell biology, genetics, molecular biology, imaging technologies, neuroscience, behavioral sciences and epidemiology to better understand the mechanisms underlying the causes and progression of orofacial pain and dysfunction associated with TMJDs and other pain conditions.

**Xerostomia:** Saliva is a remarkable fluid essential for oral health: it guards against infections by favoring the accumulation of "beneficial" bacteria and helping to eliminate other microorganisms, lubricates the soft tissues of the mouth, buffers acids produced by cariogenic bacteria, aids digestion, and facilitates speech and swallowing. Salivary gland hypofunction or obstruction can result in xerostomia or dry mouth. Xerostomia is a significant health problem, particularly among the elderly, owing to the some four hundred over-the-counter and prescription drugs, including tricyclic antidepressants, antihistamines, and diuretics that have xerostomic side effects. The most common disorder involving the salivary glands is Sjögren's syndrome, an autoimmune condition that affects between one and four million Americans, mostly middle age women. Over 30,000 individuals who have cystic fibrosis are also at higher risk for salivary gland dysfunction. In addition, each year an estimated 40,000 people lose salivary gland function as a result of radiation treatment for head and neck cancer. Whether salivary glands are irreparably damaged by disease or by radiation for head and neck cancer, the resulting loss of saliva flow markedly impairs quality of life. Without adequate saliva, people may experience difficulty speaking, chewing and swallowing. They

may also experience rampant tooth decay, mucosal infections such as candidiasis, loss of taste, and considerable oral discomfort. Currently, there is no effective treatment for this condition. New treatments such as the potential use of adult and embryonic stem cells for regeneration of salivary gland tissue and function, and gene transfer technology may offer new hope for patients with salivary gland damage or disorders.

**Craniofacial Birth Defects or Syndromes:** Craniofacial defects are among the most common of all birth defects. Birth defects and developmental disorders can be isolated or may be part of complex hereditary diseases or syndromes. Cleft lip and cleft palate are among the more common birth defects in the U.S., occurring in about one to two of each thousand births. Numerous other disorders with oral and craniofacial manifestations such as ectodermal dysplasias, Treacher Collins syndrome, Apert's syndrome, and Waardenburg syndrome, while considerably more rare than cleft lip/cleft palate, also have serious lifetime functional, esthetic and social consequences. These disorders are often devastating to parents and children alike. Surgery, dental care, psychological counseling, and rehabilitation may help ameliorate the problems, but often at a great cost and over many years. In fact, the lifetime cost of treating the children born each year with cleft lip or cleft palate is estimated to be \$697 million (Centers for Disease Control, 1992). Exciting advances in genetic studies are shedding light on genes that are important in forming the head and face, how these genes function and how they interact with environmental, nutritional and behavioral factors. Such information may ultimately provide the information necessary for prenatal diagnosis, the development of methods to prevent craniofacial birth defects, and the basis for developing better treatments. The development of biocompatible naturally-derived materials and biodegradable scaffolds offer new hope for the treatment of defects resulting from craniofacial birth defects or syndromes.

## Infrastructure Needs

**Research and Professional Workforce:** Adequately trained professionals are the lifeblood of dental education, practice and research. Oral health researchers, educators, and practitioners should reflect the diversity of America and have the broad mix of skills needed to address complex oral, dental and craniofacial diseases and conditions. However, the research and professional dental workforce does not adequately represent the composition of the U.S. population. Data show that underrepresented minority dentists play a large role in increasing access to underserved and minority populations, can influence other health professionals to be more culturally sensitive, and serve as powerful role models to other minorities and to would-be educators or researchers. The challenges here include addressing the inadequate number of underrepresented minorities in all aspects of dentistry, addressing the critical shortage of clinical researchers, and developing researchers who will be familiar with knowledge and methods from a variety of disciplines. In terms of diversity, the magnitude of the challenge is perhaps best expressed by looking at the "pipeline," or the number of underrepresented minority dentists and students in U.S. dental schools. African Americans account for 12.9% of the general population but only 2.2% of active dentists and less than 5% of students enrolled in dental schools. Hispanics comprise 12.5% of the population but only 2.8% of active dentists and 5.3% of enrolled dental students in 1999-2000. Most troubling perhaps is the 15% decline in the number of underrepresented minority first-year students in dental schools since 1990 (Valachovic, Weaver, Sinkford, and Haden, 2001).

While enrollment of women in dental schools is increasing, they are underrepresented in academics and research. Sustained efforts, new partnerships, and innovative and flexible programs are needed to ensure a competent, diverse and robust oral health research workforce. These critical national needs are identi-

fied in the Surgeon General's report on oral health ([www.nidr.nih.gov/sgr/oral-health.asp](http://www.nidr.nih.gov/sgr/oral-health.asp)) and in the National Oral Health Call to Action [www.nidcr.nih.gov/sgr/nationalcalltoaction.htm](http://www.nidcr.nih.gov/sgr/nationalcalltoaction.htm)

**Developing and Enhancing Key Research Infrastructure:** Strong research-oriented academic environments are needed to develop the intellectual talent for research, and to enable existing investigators to acquire and expand their skills in new areas of science. Oral health research can be carried out in a number of settings including dental schools, different components of academic health centers, hospitals and independent research institutions. The capacity of dental schools to conduct research and to serve as training grounds for future investigators is key to the future of clinical and applied oral health research. However, major barriers must be overcome. These include a critical shortage of faculty, a lack of integration between the basic and clinical sciences in pre-doctoral programs, inadequate incorporation of research into the dental curriculum, and financial shortfalls. Research, while exceptionally strong in some dental schools, is almost non-existent in others. Between 50% to 60% of NIDCR research support is concentrated in ten of the fifty-five U.S. dental schools. Substantial investments will be needed to bolster U.S. dental schools' research infrastructure and to ensure a workforce that is adequate both in numbers and in its ability to address the changing scientific needs.

Further advancements in science will require continued developments in technology, computer power, and analytic methods. New large databases and mathematical methods will be required to catalogue, organize and understand vast amounts of information generated from the sequence of genes or proteins. The NIDCR Scientific Expert Panel on Genomics and Proteomics ([www.nidr.nih.gov/research/genomics82002.asp](http://www.nidr.nih.gov/research/genomics82002.asp)) highlighted the need for significant development in bioinformatics, and for creating "new algorithms to analyze and interpret the data and ways to visualize

and present genomic information to researchers." The panel also suggested a number of strategies that NIDCR could pursue to make resources available to researchers and share the cost of expensive technology development.

### Strategic Initiatives

In the section that follows, the Strategic Plan identifies three major areas to achieve the NIDCR mission: (1) research opportunities, (2) research capacity, and (3) communications. Two crosscutting areas—health disparities and data acquisition and analysis—are also identified. The initiatives, goals, and objectives described are interrelated and in some cases inextricably linked. However, they are presented under discrete categories for ease of planning and developing the action steps needed to implement them, and for tracking and evaluating our success in achieving them.

Clearly, these goals and objectives do not encompass the entire range of NIDCR-supported research that collectively contributes to our overall mission. Nonetheless they capture the areas that offer the most significant scientific promise in the near-term.

### RESEARCH OPPORTUNITIES

**Goal 1.** Advance the understanding of the normal and abnormal processes underlying oral, dental and craniofacial diseases and disorders through the development and application of new technology and research tools.

#### *Genetics, Structure and Function of Oral Tissues and Cells*

**Subgoal A:** Support studies that address the genome, the transcriptome and the proteome of dental, oral and craniofacial diseases and disorders.

*Objective 1:* Identify genes, genetic and protein variations and molecular pathways associated with susceptibility to craniofacial disorders, malignancies and oral infectious diseases.

*Objective 2:* Further the understanding of gene and protein networks and signaling mechanisms associated with oral, dental and craniofacial diseases and disorders.

*Objective 3:* Identify human genetic variations for possible genetic contributions to complex disease in populations experiencing oral health disparities.

#### *Communication Between and Within Cells*

**Subgoal B:** Support research to understand the molecular mechanisms of oral cell cycle regulation related to the development and progression of oral, dental and craniofacial diseases and disorders.

*Objective 4:* Use biochemical, genomic and proteomic approaches to study cell signaling systems and pathways in the oral cells, tissues and organs of the developing and growing craniofacial complex.

*Objective 5:* Use biochemical, genomic and proteomic approaches to study prokaryotic-eukaryotic cell signaling systems and pathways, as well as prokaryotic-prokaryotic signaling within maturing microbial biofilms (dental plaque).

*Objective 6:* Examine the molecular alterations responsible for head and neck cancer development, including alteration of genes and proteins involved in cell cycle regulation, and regulatory networks controlling cell cycle progression and cell survival or death.

#### *Microbial Pathogenesis and Immunology*

**Subgoal C:** Support research on the structural and functional properties of biofilms and biofilm-mediated diseases.

*Objective 7:* Support research to further understand the normal microbial ecology of biofilms in the oral environment, including biochemistry, physiology and taxonomy of oral bacteria.

*Objective 8:* Identify and characterize microbial products involved in virulence and disease pathogenesis and interactions in mixed microbial infections.

*Objective 9:* Encourage research on the immunobiology of oral infectious diseases, cancer, autoimmunity, inflammation and microbial commensalism.

#### *Gene and Environment Interactions*

**Subgoal D:** Support research to under-

stand gene-disease associations, genes and gene products in normal craniofacial development, and gene-environment interactions in oral, dental and craniofacial diseases and disorders and birth defects.

*Objective 10:* Investigate complex multifactorial disorders of the oral and craniofacial structures that arise from the interaction of several genes and environmental components.

*Objective 11:* Identify genetic, nutritional, and environmental risk factors that influence susceptibility, severity or progression of oral, dental and craniofacial diseases and disorders and that affect the response to treatment.

*Objective 12:* Foster studies to identify environmental triggers that precipitate diseases with a specific genetic context.

#### *Pharmacogenetics*

**Subgoal E:** Understand individual variability of responses to drugs that are used for the treatment of dental, oral, and craniofacial diseases and disorders to develop highly effective, low-toxicity drugs or agents.

*Objective 13:* Establish gene expression profiles that control or regulate drug metabolism and response in different populations to predict and optimize efficacy of agents used in the treatment of oral and craniofacial diseases and disorders.

*Objective 14:* Identify biomarkers for both phenotype and genotype of different subgroups of the population that have various drug responses.

*Objective 15:* Use biomarkers to monitor and direct clinical treatment including predicting drug response, optimizing efficacy, and preventing or reducing side effects and toxicity.

#### *Biocompatible Materials*

**Subgoal F:** Support and encourage research for the design and development of "living" materials for the repair and regeneration of orofacial tissues and organs based on advances made in biological systems research.

*Objective 16:* Elucidate the mechanism leading to the formation of

mineralized structures through the support of biomimetic studies.

*Objective 17:* Encourage the use of human adult and embryonic stem cells and tissue engineering approaches for the repair and replacement of orofacial tissues and organs.

*Objective 18:* Enhance research on the interface between materials and tissues, including the development of methods to access biocompatibility and prevent rejection.

**Goal 2.** Develop new or improved approaches and methods for preventing, diagnosing, treating and eventually eliminating oral, dental and craniofacial diseases and disorders.

#### *Development and Validation of Biomarkers*

**Subgoal A:** Develop and validate biochemical, cellular, physiologic, or genetic biomarkers that can be used to predict risk, aid in early diagnosis, and assess disease progression and response to treatment of chronic and disabling oral diseases and disorders.

*Objective 1:* Utilize genomic and proteomic approaches to screen for novel biochemical, cellular or genetic markers associated with disease susceptibility, disease progression or treatment efficacy.

*Objective 2:* Conduct early clinical and epidemiologic studies to evaluate the predictive accuracy, sensitivity and specificity of known and newly identified potential biomarkers.

#### *Clinical Research and Clinical Trials*

**Subgoal B:** Expand and enhance the Institute's clinical research and clinical trials program to identify effective preventive, diagnostic and treatment approaches for oral, dental and craniofacial diseases and disorders.

*Objective 3:* Identify and validate novel and existing methods for early diagnosis and the identification of risk factors for diseases such as dental caries, periodontal diseases, oral cancer, and conditions such as chronic orofacial pain

*Objective 4:* Identify and evaluate the efficacy of novel and existing strategies for the prevention, management and treatment of oral infectious dis-

eases such as dental caries and periodontal diseases, and oral and pharyngeal cancer, particularly in populations that are at high-risk.

*Objective 5:* Define the relationship between oral infectious diseases and systemic diseases and conditions such as cardiovascular disease, preterm birth, diabetes, and pulmonary disease.

*Objective 6:* Identify and evaluate the efficacy of existing and new prevention, management and treatment strategies for chronic conditions including orofacial pain resulting from temporomandibular muscle and joint disorders.

*Objective 7:* Identify and evaluate the efficacy of novel and existing methods for preventing, managing and treating mucosal infections such as oral candidiasis, herpes simplex, and conditions such as mucositis and aphthous ulcers, especially in patients with AIDS or immune dysfunction secondary to cancer therapy.

*Objective 8:* Develop and evaluate new technologies including gene transfer therapy, drugs and biologics for treating or alleviating the oral symptoms of xerostomia and Sjögren's syndrome.

*Objective 9:* Determine the relative safety, efficacy and effectiveness of new and commonly used dental restorative materials.

#### *Population-Based, Genetics, Social and Behavioral Research*

**Subgoal C:** Support studies that expand and enhance the integration of population-based, genetic, social, and behavioral research.

*Objective 10:* Further the understanding of how genetic, biologic, social, behavioral and environmental factors interact to contribute to disease susceptibility or resistance in diseases such as head and neck cancer, caries, periodontal diseases, and conditions such as craniofacial defects or syndromes, birth defects, and chronic and disabling pain.

*Objective 11:* Elucidate the mechanisms involved in the regulation of gene expression by other variables

such as other genes, lifestyle, nutrition and the environment.

*Objective 12:* Assess and bridge gaps in the knowledge, opinions and practices of the public, educators and health care professionals about oral diseases and their prevention.

### RESEARCH CAPACITY

**Goal 3.** Ensure an adequate and well-trained research workforce that reflects the current and emerging needs of science and includes sufficient numbers of investigators from diverse disciplines and from underrepresented groups.

*Objective 1:* Increase and diversify the number of individuals engaged in oral, dental, and craniofacial research through innovative and flexible research training and career development programs at all stages of career development.

*Objective 2:* Increase the number of investigators from groups that are underrepresented in oral, dental and craniofacial research, including individuals from racial and ethnic minorities or from disadvantaged backgrounds.

*Objective 3:* Increase the number of researchers from disciplines such as bioengineering, chemistry, computer science, informatics, imaging, biostatistics, genomics, neuroscience, behavioral sciences and epidemiology working in areas that are relevant to the NIDCR mission.

*Objective 4:* Increase the number of investigators having specialized skills and knowledge in the design, conduct, and evaluation of clinical research and clinical trials in areas that are relevant to the NIDCR mission.

*Objective 5:* Increase the number of oral health professionals working in oral health research and interdisciplinary research relevant to the NIDCR mission.

**Goal 4.** Support research infrastructure and enhance the development of new approaches for conducting inter- and cross-disciplinary research.

*Objective 1:* Expand NIDCR's collaborations with public and private

research organizations, academia and industry to maximize resources and develop needed technology both nationally and internationally.

*Objective 2:* Enhance the research capacity of U.S. academic dental institutions and their ability to address changing scientific needs through improvements in the research infrastructure, including research personnel and equipment.

### COMMUNICATION

As defined in Healthy People 2010, health communication "encompasses the study and use of communication strategies to inform and influence individual and community decisions to enhance health" ([www.healthypeople.gov/Document/HTML/Volume1/11HealthCom.htm](http://www.healthypeople.gov/Document/HTML/Volume1/11HealthCom.htm)).

Consistent with that definition, NIDCR's communication efforts are meant to ensure that target audiences become informed, change behavior, and make decisions in a manner that will improve clinical care and health outcomes. Target audiences are broadly defined to include health care providers, consumers, the research community, and other groups such as educators, policymakers, industry, and the media. One of the main challenges of our health communication efforts is to find the most effective ways to communicate and disseminate health information.

**Goal 5.** Enhance the translation of research results into clinical practice and communicate science-based health information to ensure that NIDCR-supported research leads to improved health.

*Objective 1:* Communicate information to dentists, dental hygienists, educators and researchers that could be used to improve the prevention, diagnosis, management, and treatment of craniofacial, oral and dental diseases.

*Objective 2:* Communicate information to health care providers and researchers in other disciplines that could be used to improve the prevention, diagnosis, management and treatment of craniofacial, oral and dental diseases.

*Objective 3:* Increase the general public's knowledge of research findings with implications for improving oral health, in particular among parents, and high-risk, special needs and underserved populations.

*Objective 4:* Ensure that science-based information is integrated into health communication and education programs for high-risk and underserved populations as well as the general public.

*Objective 5:* Expand outreach efforts to populations with limited oral health literacy and disseminate information that is in plain language and is culturally sensitive, including languages other than English.

*Objective 6:* Support communications research to identify optimal strategies and tools for reaching various audiences and for disseminating research findings so they can be adopted widely by all who need it.

### CROSSCUTTING AREAS

Most NIDCR research areas and programs are complementary, interdependent and cut across programmatic and organizational boundaries. Indeed, it would be difficult to identify many scientific areas within NIDCR's mission that are not interrelated in some fashion. We have singled out health disparities and data acquisition and analysis as major crosscutting areas because of their far-reaching implications and contribution to NIDCR's mission:

### HEALTH DISPARITIES

To address the persistent inequalities in oral health status among U.S. population subgroups, NIDCR has developed a Plan to Eliminate Oral, Dental and Craniofacial Health Disparities ([www.nidr.nih.gov/research/healthdisp/hdplan.pdf](http://www.nidr.nih.gov/research/healthdisp/hdplan.pdf)). The objectives related to health disparities in this Strategic Plan, stated below, provide the foundation for the initiatives and detailed implementation strategies to address the persistent inequalities in the oral health of the Nation within the NIDCR Health Disparities Plan.

We are interpreting health disparities to refer to the diminished oral health status of population subgroups defined by demographic factors such as age and socioeconomic status, geography, disability status, behavioral lifestyles, gender, racial or ethnic identity. There are at least four interdependent and interacting variables that are key determinants of health, namely, the unique biology of an individual, behavioral lifestyles, environment, and the organization and financing of health care. Accordingly, addressing health disparities requires more than an understanding of the biology and lifestyle of an individual. We also must take into account the environment where the individual lives, works, and plays as well as the larger social and cultural environment. Critical to the development of effective interventions to reduce health disparities across the lifespan is the inclusion of individuals from all racial/ethnic, gender, and age groups in clinical trials. In addition, using evidence-based approaches for translating science into practice is key to ensure that NIDCR research benefits the people with the greatest needs.

**Goal 6.** Eliminate health disparities in oral, dental and craniofacial diseases and conditions among underserved populations and groups.

*Objective 1:* Encourage interdisciplinary research to understand and address the multiple factors underlying oral health disparities among U.S. subgroups.

*Objective 2:* Increase the enrollment and retention of women, children, racial and ethnic minorities and other underrepresented groups in studies conducted at NIDCR and in NIDCR-funded clinical research.

*Objective 3:* Ensure the integration of science-based oral health information into health communication and education programs for populations with high needs (racial/ethnic minorities, individuals with disabilities, and other susceptible populations.)

## DATA ACQUISITION AND ANALYSIS

Documenting the full extent and magnitude of the many oral, dental and craniofacial diseases and conditions is critically important. Given the wide implications and significant impact of the many oral and craniofacial conditions and diseases, we must continue to determine their prevalence, incidence, and co-morbidity and their effect on physical health, quality of life, and social and economic impact. However, reliable measures and data are lacking for common diseases in selected populations and for many less widespread conditions in the U.S. population in general. Baseline and trend data are needed for demonstrating progress in improving the nation's oral health and to provide a key foundation for research efforts to improve oral health.

The changing U.S. demographic profile brings additional responsibility to collect information on the oral health of many more and increasingly diverse population subgroups. Adequate and reliable national data are lacking for common conditions for many racial and ethnic minority groups and other vulnerable populations, and for less prevalent oral, dental and craniofacial conditions in the U.S. population. At the same time, there is a need for continued assessment and revision of survey methods and designs, enhancing the capacity for longitudinal follow-up of participants while maintaining privacy, and increasing the inter-relationship among surveys. Data acquisition and analysis, particularly among unique population subgroups, will benefit from collaborations with other Federal agencies as well as with patient and community groups, state and local-based organizations, foundations, industry and others in the private sector.

**Goal 7.** Ensure the adequacy of systems to document and monitor the extent and impact of oral, dental and craniofacial diseases, disorders and conditions.

*Objective 1:* Identify and validate new methods to measure and document oral, dental and craniofacial diseases, disorders, conditions, risk factors and markers in population-based studies.

*Objective 2:* Assess the social, educa-

tional and economic impact of oral, dental and craniofacial diseases, disorders, conditions, and birth defects.

*Objective 3:* Assess and monitor changes in disease status, access to care, and the utilization of professional, community and self-care oral health services.

## NIDCR Planning and Priority Setting

The areas NIDCR chooses to emphasize in its solicited extramural and intramural research are selected through long-term and short-term science planning. Planning activities develop and use information from a number of different sources and consult a broad range of key external stakeholders. These individuals and organizations include:

- The extramural scientific community, including both individual researchers and professional societies;
- Patient organizations and voluntary health associations that may deal with the NIDCR directly or indirectly through Congress and the public media;
- The Congress and the Administration;
- The National Advisory Dental and Craniofacial Research Council and the NIDCR Board of Scientific Counselors;
- Other NIH Institutes, program offices, and other federal agencies;
- Industry, and;
- Ad hoc advisory groups.

In addition, the Institute relies on input gleaned through a variety of conferences and workshops. These include collaborative, trans-NIH scientific conferences and workshops that constitute reviews of emerging scientific opportunities, public health concerns, or state-of-the-science assessments, many of which outline specific areas of research that should be the target of future initiatives or activities. Consensus development conferences also may be held. Finally, NIDCR's planning and priority setting occurs in a larger context, including areas of emphasis determined by Congress, the Department of Health and Human

Services, and NIH; a highly refined peer review process; the annual congressional appropriation; and other factors.

Evaluation research is an important tool to assist NIDCR with planning, management, and accountability. At the Institute, evaluation is defined as objective, systematic research that uses scientific criteria and analytical techniques to measure the effectiveness of program implementation and/or the impact of program results. Comprehensive evaluation projects are conducted for key disease-based and crosscutting areas of NIDCR's portfolio of research and activities. Areas are selected for evaluation on the basis of several criteria, including the prevalence and impact of related diseases or conditions, NIDCR resources, the current state of the science in that area, and the recommendations of Council and other advisory groups.

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### I. NIDCR and Public Health Service

National Advisory Dental and Craniofacial Research Council  
 NIDCR Board of Scientific Counselors  
 NIDCR Patient Advocates Forum  
 US Public Health Service Oral Health Coordinating Committee

### II. Outside Organizations Represented at Stakeholders Meeting

American Academy of Pediatric Dentistry  
 American Academy of Periodontology  
 American Association for Dental Research  
 American Association of Endodontics

## Acknowledgments

This plan is a collaborative effort that included input from many individuals and organizations—the Institute's senior staff and National Advisory Dental and Craniofacial Research Council (NAD-CRC), NIDCR staff, researchers, academics, professional organizations, public health communities, patient groups, Federal committees and the public. We are grateful to all who contributed to the development of the plan, and to the many outside organizations and individuals who provided comments on the draft document. In addition to the public comments that were invited through the NIDCR website, we convened a meeting of outside constituents to receive their input. This stakeholders meeting included representatives of professional dental organizations, including research, education, organized dentistry, dental specialties, patient advocates and industry. A special session was also held during the May meeting of the NIDCR Patient Advocates Forum to invite their input and comments, and presentations were made to the Associate Deans for Research during the 2003 Annual Session of the American Association for Dental Research and to the US Public Health Service Oral Health Coordinating Committee.

Special thanks to Dr. Isabel Garcia who led this effort, to Dr. Frank Macrina, the National Advisory Council representative for the project and who chaired the stakeholders meeting, to the individuals who assisted during that meeting—the breakout group facilitators Dr. Skip Collins, Dr. Rick Valachovic, and Mrs. Kathy Hammitt,

and the recorders Dr. Rob Selwitz, Dr. Kevin Hardwick, Ms. Karina Boehm, Ms. Ellie Murcia, Drs. Kathy Hayes and Wande Morgan. Our thanks to Ms. Jody Dove, Ms. Susan Johnson, and Dr. Mike Barnett, for their helpful suggestions and editorial comments.

In 2001, the Institute established an internal study group with representatives from all of its Divisions to identify broad areas of importance to NIDCR's long-range scientific agenda. This group identified three main areas of interest: genomics and proteomics; repair and regeneration of oral, dental and craniofacial tissues; and clinical research. Expert panels were then convened during the summer and fall of 2002 on each of these three topics to assist the Institute in identifying areas of scientific opportunity, and to catalogue, in general terms, the resources required to successfully address them. An additional expert panel on research training and career development was held to build upon the previous work carried out by the 1999 NIDCR Blue Ribbon Panel on Research Training and Career Development ([www.nidcr.nih.gov/research/blueribbon/summary.pdf](http://www.nidcr.nih.gov/research/blueribbon/summary.pdf)). The reports of these expert panels along with other resources were used to develop specific research objectives for the updated plan. The objectives and activities set within the plan go hand in hand with the overall Institute's planning, budget, and evaluation activities and address research needs identified in Oral Health in America: A Report of the Surgeon General, the oral health objectives of Healthy People 2010, and the National Oral Health Call to Action.

American Association of Public Health Dentistry  
 American College of Prosthodontics  
 American Dental Association  
 American Dental Education Association  
 American Dental Hygienists' Association  
 American Dental Trade Association  
 Colgate Palmolive Company  
 Dental Manufacturers of America  
 Friends of the National Institute of Dental and Craniofacial Research  
 Hispanic Dental Association

National Dental Association  
 National Foundation for Ectodermal Dysplasias  
 Oral Microbiology and Immunology  
 Sjögren's Syndrome Foundation  
 The Paget Foundation  
 The Procter and Gamble Company

*III. Organizations Represented at NIDCR Patient Advocates Forum*

About Face USA  
 Cleft Advocate, Inc  
 Cleft Palate Foundation  
 FACES: The National Craniofacial Association  
 Jaw Joints & Allied Musculo-Skeletal Disorders Foundation, Inc.  
 Juvenile Diabetes Research Foundation  
 National Foundation for Ectodermal Dysplasias  
 National Healthy Mothers, Healthy Babies Coalition  
 National Marfan Foundation  
 Osteogenesis Imperfecta Foundation  
 Scleroderma Foundation  
 Sjogren's Syndrome Foundation  
 Special Olympics University  
 The Paget Foundation  
 The TMJ Association  
 Trigeminal Neuralgia Association  
 Wide Smiles

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**Reports and Supporting Documents**

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[www.nidr.nih.gov/research/genomics82002.asp](http://www.nidr.nih.gov/research/genomics82002.asp)  
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# Issues in Dental Ethics

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## Rights Access and Justice in Oral Health Care: Justice Toward Underserved Patient Populations—The Elderly

Mary McNally, MSc, DDS, MA, FACD

### ABSTRACT

Recent data indicate that health utilization, calculated on the basis of visits to physicians, specialists, surgery rates, and hospitalization stays, increases with age. Yet, visits to the dentist decrease with age. Although dentistry has made dramatic improvements in the provision of oral health care over the past half-century, access-limited populations including older adults are burdened with the poorest lev-

els of oral health. Many factors contribute to the oral health problems faced by elders. Also, because of its marginalization from general health and public health care delivery systems, oral health does not garner meaningful consideration as a social good. Needs associated with oral health cannot be met without a rethinking of concepts that define oral health and recognition of its impact on general health and quality of life. Determining the extent to

which elders endure an undeserved or unreasonable burden of illness and disability is an important first step toward



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understanding the meaning of "justice" in the context of caring for elders. A clearer understanding of justice allows the oral health community to begin to recognize appropriate levels of responsibility to address the issue of just and respectful caring for this vulnerable population.

**T**he aging phenomenon emerges as one of the most significant health issues of the twenty-first century, with many special challenges developing in its wake. Although mine is a Canadian perspective, most of my discussion mirrors trends occurring elsewhere in the world. Like other developed countries, Canada has a large and growing aging population that challenges social and health institutions to develop a better understanding of the needs associated with this changing demographic. The aging population is expected to have a major impact on all manner of health care delivery—including oral health.

While Canada is well known for its universal healthcare system, it often comes as a surprise to international audiences that oral health care is *not* included under the rubric of publicly funded healthcare in Canada and my home province of Nova Scotia. Nova Scotia—one of the tiniest and oldest provinces in Canada—is virtually an island that is connected to the rest of Canada by a narrow isthmus. The coastline is diverse and bountiful and there is no place in Nova Scotia where it is more than an hour drive to the ocean. It is beautiful, quiet, and safe—so, it is a retirement haven. Also, Nova Scotia's location on the east coast is a significant distance from the business and industrial core of central Canada. Another demographic reality is that Nova Scotia loses its youth to jobs and opportunity in central Canada. Both of these trends result in a disproportionately high number of elders in our province. While the rest of Canada is expected to have 14% of the population over the age of sixty-five by the year 2010, we are virtually there already. Nova Scotia has the oldest pop-

ulation in Atlantic Canada and the third oldest population in Canada (Nova Scotia Senior Citizen's Secretariat, 2003). This has special and practical significance to health care and its delivery for Nova Scotians. By any standard, older people have more health problems than younger people and, as a rule, use more health services.

Although dentistry has made dramatic improvements in the provision of oral health care over the past half-century, access-limited populations including older adults are burdened with the poorest levels of oral health. In 2000, the US Surgeon General (U.S. Department of Health and Human Services, 2000) recognized the serious situation facing marginalized groups such as the aged as the "silent epidemic" of oral disease. Some of

cohort ages. Compelling research has been carried out to address the impacts of aging in a variety of contexts—for example, epidemiological, economic, educational, and clinical. But like many other issues in dentistry, this "silent epidemic" has not been the subject of meaningful philosophical inquiry. In other words, this issue is rarely framed as a moral one.

In a recent plenary presentation at the Annual Conference for Special Care Dentistry, Marsha Pyle proposed this scenario as "a set up for future disaster as chronic disease, frailty, and functional dependence contribute to declining oral health. The well-documented (poor) oral health status in long-term care facilities today is the prime forecaster of the magnitude of this problem on oral health in

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*It assumes that, even though we have equal moral worth, we are not all equal agents and therefore have a particular responsibility to disadvantaged or vulnerable groups that goes beyond distribution schemes. Elders are one such group.*

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the factors contributing to oral health problems for seniors include: the unprecedented retention of natural teeth with aging, socio-economic disparities, lack of appropriate dental care, lack of prevention/health promotion programs, inadequate training of oral health professionals, as well as inaccessibility to care-providers and to oral health insurance programs, public or private. Delivery of care that depends on the prevalent "private practice/fee-for-service model" results in treatment for elders (and particularly institutionalized elders) that is sporadic and sparse.

Like other health professions, dentistry has a burgeoning problem to face in addressing health concerns associated with aging. In keeping with the expected retention of natural teeth, oral health care providers will be required to address significant changes in treatment needs especially as the baby-boomer

the future" (Pyle, 2002). Pyle outlines many of the practical barriers facing care providers, educators, policy-makers, and elders themselves in the quest for adequate oral health care. Although she does not explicitly identify moral shortcomings as part of her analysis, she challenges stakeholders to respond to the question "what will it take to leave no senior behind?" To me, this question resonates beyond the practical issues she and others have identified. It connotes a requirement for deliberate reflection about the scope of moral obligation that must be part of the answer.

It is difficult to think of a good society that does not care for its elders. But, resolving practical problems does not encompass all that it will take to ensure that the health needs of elders are met. To adequately respond, there must be a clear sense that meeting the health needs of vulnerable elders is something that

ought to be done. By identifying the issues and then by appealing to various theories of justice, we will be able to examine the grounds on which to defend the argument that elders *should not* be "left behind" when it comes to matters of health and oral health.

I will briefly review what we might mean by "justice" in the context of caring for elders as well as some of the special challenges facing this population group. I will suggest appropriate goals of health care intervention for elders and will conclude by considering appropriate levels of responsibility to address this issue.

to attempt to distribute them in the manner of material goods. For her, it is the social processes, not the end state patterns that reflect social justice. In this sense, justice is more than "equal distribution amongst equal agents." It assumes that, even though we have equal moral worth, we are not all equal agents and therefore have a particular responsibility to disadvantaged or vulnerable groups that goes beyond distribution schemes. Elders are one such group.

With these various conceptions in mind, how must we situate our thinking to ensure that elders have a decent chance at good health and that they are

2001). It is not surprising that the number of patients expected to be experiencing dementia-related diseases will double or even triple in the same time frame. This presents significant treatment challenges for health professionals.

Coupled with this demographic phenomenon is the widespread belief that the aging of the baby-boomer generation is creating an unsustainable pressure for health services. Are older people at risk for becoming scapegoats for rising health care costs? Might this attitude propagate unjust discrimination against elders seeking health care? Furthermore, what is the meaning and importance of older persons in society? The classical view of older persons who are respected because of their wisdom and experience has changed in the age of Internet. How does this affect society's attitude toward the aged and its willingness to foster appropriate social arrangements on their behalf?

And, what is the right measure of health? In keeping with the World Health Organization's broad definition, most of us would perceive health as more than the "absence of disease." How do we begin to decide what aspects of health—and more specifically oral health—might be worthy of attention in the pursuit of justice in health care? To answer this question, we need a better grasp on the meaning of oral health itself. Judgments about the provision of resources for health services ultimately rest on assumptions about the meaning of "health." Causally, there is a connection between oral health and general health yet they are invariably considered apart. The duality of mouth and body is of practical importance in the provision of health care but it is also an interesting conundrum that has received little, if any attention in the philosophical literature. Beyond the philosophical interest, this separation of mouth from body has important ramifications within the arena of social justice where health issues concerning the mouth—because of its separation from the body (and hence from the entire health care system in Canada)—have not garnered profession-

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### *Care must be focused toward decreasing morbidity and disability while providing care that supports increased participation and interaction.*

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The simplest definition of justice refers to "fairness" or "entitlement." And the concept that is concerned with the distribution of goods and services—as in the context of public policy concerning health resources for example—is referred to as "distributive justice." Although theoretical formulations establishing a fair and equitable distribution of benefits and burdens among members of society is a commonly held definition of social justice (Beauchamp, 2001), other concepts of social justice go beyond theoretical formulations of distribution. For some, "social justice" refers to social arrangements that include a positive obligation to alleviate unjust burdens (such as burdens of illness, poverty, discrimination, and so on)—and to ensure fair relations amongst social groups (for example old and young; women and men) that might not be achievable by merely considering distributable goods. According to Iris Young (1990), a scheme that may be appropriate for the distribution of material goods cannot be extended for the distribution of non-material social goods such as rights, opportunities, and self-respect. Young argues that these are not available in measurable quantities so it defies logic

not the subjects of undue burdens of poor health? Although we must include practical issues that respond to redistribution of social resources in our analysis, I would argue that we also think beyond "who gets what?" We must examine what we, as a society, must do to identify and respond to the unique challenges facing elders that may not be completely captured by equitable resource allocation. We must examine our attitudes, beliefs, prejudices and, commitment to caring for this vulnerable population.

Clearly, the inevitable demographic shift already described is a basis for concern over the future of health care provision for the elderly. It is a safe estimate that the demographic trend in the developed world will result in approximately one in five, or 20% of the population over the age of sixty-five by the year 2030. Due to a concomitant increase in life expectancy, the population aged eighty and over is currently the fastest growing age group Canada. Over the past decade, this group incurred the largest percentage increase of any age group (41%) to 932,000. During the next decade, the population of those eighty and over is expected to continue to rise to 1.3 million (Statistics Canada,

al or public interest.

In its attempt to alert citizens to the "full meaning of oral health and its importance to general health and well-being," the U.S. Surgeon General's Report (2000) took specific aim at this duality, sharply focusing problems arising from the marginalization of oral health from general health. For example, disease and disability originating in the oral cavity can have far-reaching systemic consequences for elders. "Poor oral health and tooth loss in the elderly results in a reduction in the ability to chew and marked changes in dietary preferences. Studies of hospital and nursing home populations have indicated that poor oral health and problems chewing are linked to low body mass index and involuntary weight loss. In turn, these have been associated with increased morbidity and mortality" (Locker and Matear, 2000).

And, in keeping with a broad conception of health, the oral cavity, with its location in the center of the face, should not be considered only in terms of its impacts on physical health. The ability to communicate and socialize effectively, and the impact on self image and personal dignity—no matter how old we are—has a profound impact on quality of life and, ultimately, healthy aging. What do I mean by "healthy aging?" Natural phenomena associated with the aging process are at risk for being confounded with symptoms of ill health. With images of decline and disability associated with aging, and the current preoccupation with youth and beauty in our society, the potential demand for health care by elders generates enormous concern amongst researchers, service planners and providers. On the other hand, some suggest that an emphasis on illness and dependency and a focus on curative interventions in health care practices for the aged is misguided. Rowe and Kahn (1987) speculate, for instance, that a positive attitude to life, maintaining autonomy and maintaining active social interaction may actually contribute to well-being and overall longevity even

though these observations cannot be empirically translated into measurable physiological benefits of health such as lowering blood pressure or cholesterol. They propose shifting the emphasis on healthy aging away from a purely curative focus toward goals associated with optimal functioning.

It is also interesting that attitudes toward disease and disability vary between and within age cohorts. For example, 75% of older Canadians report their health as good to excellent in spite of the fact that most also report restrictions to regular daily activity or the presence of chronic illness (Rosenburg and Moore, 1997). In spite of positive perceptions of health by elders themselves, research in aging has tended to focus on losses associated with aging.

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### *The oral health profession as a whole must work to develop age-sensitive practice guidelines.*

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Rowe is concerned that research emphasizing average or usual age-related losses inappropriately neglects heterogeneity within the aging population. By paying attention to heterogeneity and to extrinsic factors that contribute positively to those who age successfully, Rowe argues that strategies can be developed to address and minimize the impact of losses associated with aging (Peck, 1987). Not all differences are a matter of genetic endowment and in fact, "a major component of many age-associated declines can be explained in terms of life style, habits, diet, and an array of psychosocial factors extrinsic to the aging process" (Rowe and Kahn, 1987). Rowe's and Kahn's work in the early 1980s is still influential in focusing attention on factors that contribute positively to "robust" aging which has subsequently been described as a combination of three important qualities: (1) low chance of disease and disability, (2) maintenance of cognitive and physical function, and (3) active engagement in social relations and productive activity. Keeping in mind a commitment to respectful and compassionate use of science and tech-

nology in the provision of health care for elders, our goals should be directed toward these important qualities. Because of the potential impact that poor oral health has on all three of these qualities, care must be focused toward decreasing morbidity and disability while providing care that supports increased participation and interaction.

So in the face of the many practical and philosophical challenges outlined, who are the players that will influence justice? Individual care providers must become sensitized to issues of ageism and the risk of discrimination and value judgments where elders are concerned. Treatment goals must be in keeping with healthy aging and standards of care must be reviewed to ensure realistic, respectful treatment goals. As oral

health care providers, it is often difficult to offer treatment options considered less than optimal under normal circumstances. Nevertheless, it is not always the case that everything that can be done should be done especially where frail elders are concerned. It is also up to individuals to attempt to work collectively to support efforts to enhance access to care. Secondly and following from this last point, the oral health profession as a whole must work to develop age sensitive-practice guidelines; it must be involved in continued needs assessments for elders and attempt to create inter-professional awareness to circumvent the marginalization of oral health from general health. The profession must also reflect seriously on political barriers affecting access to care and play an advocacy role in the interest of vulnerable populations such as the aged.

Although the Surgeon General's Report has gone a long way to creating awareness about the issue of access-limited populations, continued efforts must be made to engage society as a whole to support initiatives that recognize this issue as a priority. For example, the pub-

lic sector must work to establish policies that include dental services as part of the overall concept of health care for elders. Public and private sectors must find mechanisms of cooperation to formulate new models in the delivery of oral health services. With respect to elders, policy initiatives that are focused on prevention and health promotion could profoundly curtail the need for expensive, technologically invasive, curative procedures in the first place. If such social policy initiatives are effective, there is no reason to assume that this approach would be prohibitively expensive. Unfortunately, the problem we have in dentistry is that currently, virtually no dental expenses are incurred by the public purse. Therefore, to introduce social policy to include preventive oral care and oral health promotion would be viewed as a totally new expense. In order to satisfy policy-makers that oral health should be on the social agenda, more evidence is required to break down the conceptual barriers that separate oral health from health in general. More collaborative research is required for us to understand the impact of poor health originating in the oral cavity on other systems. From a purely fiscal standpoint, more research needs to be carried out to determine the real public costs of a system that relies solely on private delivery of service.

And lastly, what educational objectives and competencies will be required to establish "a pedagogy for justice in oral health care" in dental education? Allotting more money to dental schools does not ensure that more graduating students will treat elders. Besides heightening awareness and sensitivity to

issues and barriers associated with treating elders, education strategies must be developed to counterbalance the various agendas that drive curricula to be exclusively focused on highly technical, restorative, rehabilitative and cosmetic interventions. Curriculum priorities that are disproportionately weighted toward technical experiences and competencies risk displacing other "less interesting" or "less profitable" education outcomes. Dental educators must also create awareness amongst those entering their professional careers. They must model a range of practice patterns that include long-term care facilities, community centers, home visits and so on. Also, increased academic collaboration to break down inter-professional barriers could go a long way toward minimizing the duality between mouth and body.

There is no question that aging, with the inevitability of physical decline, sharply focuses for caregivers, policy makers, and ethicists questions of appropriate care for healthy and robust aging. The meaning and correct measure of oral health is another important influence on healthy aging that warrants further inquiry. Determining the extent to which elders endure an undeserved or unreasonable burden of illness and disability is an important first step toward understanding the meaning of "justice" in the context of caring for elders. A clearer understanding of justice allows the oral health community to begin to recognize appropriate levels of responsibility to address the issue of just and respectful caring for this vulnerable population. The purpose of this discussion was to open the conver-

sation, to begin a meaningful reflection to recognize and respond to ethical obligations related to oral health care for elders, and ultimately, to ensure that "no senior is left behind."

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# Standards

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## Abstract

We use standards to raise the general quality level and to identify and encourage those who lag behind. Standards agreed by professional organizations are the best. There are differences between licensure and certification in the mechanisms for creating standards, the level at which standards are set, how data are gathered, and the types of decisions they support. There is also a danger that standards can be hijacked for commercial purposes.

It is human nature to compare. Dentists read surveys of practice income and attend conventions to find out whether they are “up to date.” If they are like physicians, dentists get most of their practice information and most of their opinions about what is appropriate in practice from talking with their colleagues. We find out who we are by looking at others. We advance toward our goals by striving to accomplish those things approved by those we respect.

There are, however, many ways of making such comparisons, ranging from the casual conversation that leads to the incidental borrowing of an innovation in office procedures to dental offices applying for the Malcolm Baldrige National Quality Award—the most prestigious prize offered in America for performance excellence in industry, service, education, or health care. Between these extremes are the interesting cases of licensure, certification, and commercial recognition.

## Licensure

A license is a government-backed opportunity to engage in an exclusive and self-supervised commercial activity. Those who lack licenses are excluded from commercial participation, normally on penalty of legal action. The license is granted in exchange for economic consideration (in the case of legally enforceable rights to use intellectual property) or to companies or individuals based on capacity and faithful performance of valued services. Licenses prescribe what can and cannot be done, what levels of performance are required, and how the business is to be conducted.

be revoked for grossly incompetent performance, failure to maintain currency of certifications—such as basic life support, or criminal or unsafe practice.

Licensure establishes a minimal standard of competence. It would be tragic for the public and the profession if dentists aspired to perform at the licensure level. Continued competence would be a similar disaster—if it is understood that dentists or hygienists are expected to perform at the same skill levels they possessed when they first began practice.

Licensure standards are codified in a set of laws and regulations, with their creation and enforcement being a collab-

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With some variation from state to state, dental and dental hygiene licenses in the United States are granted initially based on meeting five criteria: (1) graduation from a U.S. accredited school, (2) passing a written, nationally standardized set of examinations, and (3) a patient-based performance examination of a small fraction of the competencies practiced in dentistry, (4) lack of a criminal record inconsistent with public service, and (5) payment of a fee. Such licenses are renewable annually or biannually based on collateral activities such as attendance at continuing education courses and payment of fees. Licenses can

oration between the profession and state agencies. Political realities influence licensure standards, as in California where laws sometimes allow graduates of non-U.S. accredited schools to sit for licensure examinations based on having successfully passed a mannequin test or allowing a limited number of graduates of approved non-U.S. schools to practice in underserved areas. As a general rule, investigation of licensure infractions is not a well-funded branch of government and actions to remove licenses can be beyond the means of boards to litigate. Malpractice and insurance management probably set higher practical standards



for dental practice than does the licensure process.

There are other mechanisms for dental practice that have similar general characteristics. Hospital privileges, extended functions such as anesthesia for hygienists or conscious sedation for dentists, qualification to charge higher fees in certain insurance plans, and practice privilege lists in the federal services have the same patterns of exclusive opportunity based on a profile of qualifications, with minimal and broadly applied standards.

tion programs—DDS and DMD programs, hygiene, assisting, postdoctoral general dentistry, and specialties. The Joint Commission on Accreditation of Healthcare Organizations accredits hospitals, clinics, and even oral surgery offices.

Unlike licensure which is a joint effort of the group and the state, certification is almost entirely managed by arm's-length affiliates of the groups whose members are certified. It is a mechanism designed to promote higher

have estimated the reliability of initial licensure testing at  $r = .40$ —an unacceptable value by psychometric standards. Each year, approximately 4% of practitioners who are granted licenses have them revoked or disciplined.

By contrast, certification and accreditation must be grounded in evidence. The USDOE mandates that CODA perform reliability and validity studies and present the findings at least once every seven years. Other standards organizations such as JCAHO, Baldrige, and the International Standards Organization have scientifically based models of performance excellence for their certification standards.

A second broad difference between licensure and certification involves the assembly of evidence. In the case of licensure, boards conduct examinations or otherwise gather data. In certification, the candidate assembles the evidence according to published standards. The certifying group announces standards and offers guidelines about evidence, but it is up to the candidates to make the case that they meet criteria. This is known as a portfolio approach to evaluation. The portfolio model is appropriate to certification—where a higher standard of performance is expected—because it is less prescriptive and recognizes that excellence entails diversity while minimum standards might be prescriptive.

It has become a distinctive feature of certification in recent years to be based on outcomes assessment. Continuing education hours, degrees held, or years practiced are all examples of process measures—they speak to quality indirectly, if

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## Certification

Certification refers to a range of voluntary processes sponsored by groups to promote higher standards among their members. There is no requirement that accountants be licensed, but those who are certified have demonstrated high qualifications and performance. Similarly for underwriters, real estate agents, association executives, periodontics, childcare providers. When organizations are certified, it is generally called accreditation. The Commission on Dental Accreditation is accredited by U.S. Department of Education. CODA accredits fourteen types of dental educa-

tion levels of performance. The group establishes comprehensive standards, conducts assessments, and determines certification or accreditation status. Two differences between licensure and certification concern grounding of standards and collection of evidence.

There are no requirements that licensure be based on evidence that the licensure decisions are reliable or valid. For example, in dentistry state and regional testing agencies do not publish the consistency of examiners and there has never been any published evidence that the public is protected by such a mechanism as initial licensure. In a paper accepted for publication in the ADA Journal, I

	LICENSURE	CERTIFICATION	COMMERCIAL RECOGNITION
<b>Participation</b>	Required	"Voluntary"	Sought
<b>Conducted by</b>	State / profession	Third parties	Interest groups
<b>Purpose</b>	Exclusive commerce	Improvement	Personal gain
<b>Standard</b>	Minimal acceptable	Promotes change	Uncertain
<b>Evidence</b>	By agency	By candidate	Any source
<b>Criteria</b>	Mostly process	Mostly outcomes	Mostly reputation



at all. Outcomes are cases presented and patient-based health measures.

Any meaningful approach to evaluating practicing dentists over their careers will probably involve a certification rather than a licensure mechanism. We expect professionals to grow and to customize their practices to realistic requirements in their unique settings. Asking a veteran endodontist to demonstrate skill on a Class II amalgam restoration makes no sense. Having them present endodontic records and cases does. Specialty boards and the Academy of General Dentistry use a certification model appropriately.

Certification is referred to as "voluntary," but the term is not accurate. There is no requirement that American dental schools must be accredited. However, federal loans are not guaranteed, government research funding is constrained, and graduates of unaccredited schools can sit for licensure examinations only in very rare cases. What has happened is that third parties have tied certain privileges to certification. The government and insurance carriers have certain qualifications for participating dentists, hospitals will only grant privileges to practitioners with certain certifications, oral surgeons seek JCAHO certification in order to bill at physician rather than dentist rates. Certification works internally within organizations to raise standards; it works externally as a guarantee of quality above licensure that third parties do not have to pay for.

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### *There are organizations that exist primarily to provide certifications for economic advantage.*

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#### **Commercial Recognition**

There are organizations that exist primarily to provide certifications for economic advantage. *U.S. News & World Report* ranks American universities—as a way to sell magazines. Some commercial organizations rank dentists for the same purposes. There are for-profit organizations that publish directories of plumbers, exterminators, and bail

bondsmen that meet quality standards and these publications charge the business, the customer, or both. There are similar organizations in dentistry. There are even dentists who form groups to promote a particular approach to treatment. They claim or imply superiority for their members. Some of these "academies" or "institutes" actually raise the level of quality of their members, some raise primarily the appearance of quality.

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A variation on this theme is the modern stampede toward "prizes." Recognizing the "best" of a group's members has become a fashionable means of publicizing the member and the organization at the same time.

It is not possible to draw a bold line between commercial recognition and certification. It is a matter of the relative emphasis on commercial benefit and improved quality. It is wise to look for participation by a third-party that is non-profit. All accreditation agencies, The Joint Commission on Accreditation of Healthcare Organizations, and the International Standards Organization meet this criterion. The Academy of General

ment is curtailed in an effort to be fair and to make defensible decisions, what is measured tends to become trivialized. It is never practical to assess more than a sample of professional performance. Good licensure and certification systems are those that evaluate a representative sample of the full range of characteristics and do so with enough confidence to minimize major errors.

There are statements that resemble

standards but function differently because they are not part of the licensure or certification processes. Among the standard-like statements are protocols, critical paths, best practices, standards of care, parameters, or generally, guidelines. All of these operate within an organizational context—from a solo practice, to a network of providers, and even an entire profession—to improve practice, not to assess the practice or the practitioner.

Protocols are standardized approaches to general problems. Standing orders for bitewing radiographs on new patient examinations (while questionably ethical because they involve auxiliaries in delivering care prior to the dentist's individual diagnosis) are an example of a typical office protocol. Antibiotic prophylaxis, basing preps of a certain depth, and sectioning teeth of certain shapes prior to extraction are better examples. Protocols do not guarantee successful outcomes, but good ones are based on evidence and experience and increase the likelihood of successful performance and successful defense of untoward outcomes, while reducing treatment time. The Canadian Dental Association has embarked on an ambitious project to publish evidence-based protocols on the Web. Sometimes protocols are called

Dentistry and specialty boards are non-profit, but they are not third parties.

#### **Guidelines**

There are standards or criteria in licensure and certification. These are statements about what to look for, how to do the looking, and what constitutes acceptable findings. No set of standards can be complete or objective. As judg-



guidelines or critical paths. Although not rigid distinctions, guidelines are typically generated by third parties—such as specialty groups, insurance carriers, or associations. Critical path is a term heard more often in the hospital context, especially in hospitals that are engaged in quality improvement programs. A critical path is a guideline that is very specific, multistage, and very tightly bound to diagnostic categories.

Best practices are also guidelines, but they tend to be emerging protocols, collected from a group's members and

shared with a view toward stimulating innovation. There has long been a controversy between quality experts who support "best practices" and those who favor "best fit." Proponents of the latter position place greater weight on context specific circumstances and caution that what works wonderfully in one situation may not work as well in different settings.

The American Dental Association has developed parameters of care. There is a good deal of the "best fit" thinking in the parameters approach. These are principally characterizations of the fea-

tures of good practice across a huge range of conditions rather than specific protocols.

The standard of care is also a set of guidelines. The difficulties with the standard of care as a guideline to practice is that it varies by locale (not scientific evidence that can be verified in advance of treatment) and that it is subject to wide interpretation. Compounding the interpretation problem is the fact that various interpretations are available for purchase.



## Recommended Reading

\* American Dental Association. *Accreditation Standards: Predoctoral Dental Education*. Chicago, IL: The Association.

Twenty-four standards in six areas (organization, curriculum, students, faculty, clinic, and research) that comprise the criteria for accrediting dental schools. (There are other documents describing auxiliary, postdoctoral general education, and specialty education.) The standards are largely expressed in terms of outcomes and competencies of the beginning practitioner.

\* Joint Commission on Accreditation of Healthcare Organizations (2002). *Standards for Ambulatory Care*. Oakbrook Terrace, IL: The Commission.

A presentation of the standards, rationale, self-assessment, and application process for accreditation of organizations that provide health care in ambulatory settings. Among the standards are ethics, patient assessment, care, education, and continued care of patients and organizational performance, leadership, infection control, and management of the environment, human resources, and information.

\* National Institute for Standards and Technology (2003). *Baldrige National Quality Program: Health Care Criteria for Performance Excellence*. Gaithersburg, MD: The Institute.

The Baldrige Prizes have been awarded by the U.S. Department of Commerce since the late 1980s. The health care criteria are based on the same model that underlies performance excellence in industry, service, and education: leadership, strategic planning, focus on the patient, information and analysis, staff, process management, and organizational results. There are also a set of core values. The criteria explain the program and scoring for the prize.

[www.abda.ab.ca](http://www.abda.ab.ca)—Comprehensive protocol project sponsored by the Alberta Dental Association.

[www.ada.org](http://www.ada.org)—[Dental Practice Parameters] Characteristics of effective dental practice in thirty-nine areas such as edentulous arches, impacted/unerupted tooth, and pulpitis.

[www.cochrane.org](http://www.cochrane.org)—Largest collection of evidence-supported healthcare practice.

[www.cda-acd.org](http://www.cda-acd.org)—Evidence-based dental protocols.

[www.cochrane.org](http://www.cochrane.org)—The world's largest collection of evidence relative to the effectiveness of various healthcare procedures.

Your state's dental practice act—look to see if it really says "protect the public."

### Editor's Note

Summaries are available for the three recommended readings preceded by asterisks. Each is about four pages long and conveys both the tone and content of the original source through extensive quotations. These summaries are designed for busy readers who want the essence of these referenced in fifteen minutes rather than five hours. Summaries are available from the ACD Executive Offices in Gaithersburg. A donation to the ACD Foundation of \$15 is suggested for the set of summaries on standards; a donation of \$50 would bring you summaries for all the 2003 leadership topics.

# Manuscript Review Process, 2003

Six unsolicited manuscripts were considered for possible publication in the *Journal of the American College of Dentists* during 2003. Three were returned to the authors because they did not match the editorial policy of the journal. None of the reviewed manuscripts were accepted for publication.

Thirteen reviews were received, 4.3 per manuscript. All of the reviews that expressed a clear view were consistent with the final decision regarding publication. Cramer's V statistic, a measure of consistency of ratings, could not be calculated, but the consistency among reviewers is certainly high. There is no way of comparing the consistency of the reviews for this journal with agreement among other publications because it is not customary for other journals to report these statistics. The College feels that authors are entitled to know the consistency of the review process. The Editor also follows the practice of sharing all reviews among the reviewers as a means of improving calibration.

The Editor is aware of four requests to reprint articles appearing in the journal and one request to copy articles for educational use received and granted during the year.

In collaboration with the American Association of Dental Editors, the College sponsors a prize for a publication in any format presented in an AADE journal that promotes excellence, ethics, and professionalism in dentistry. Eighteen manuscripts were nominated for consideration. The winner was a case regarding the ethics of commercial product development, "In Whose Interest?" appearing in the November-December 2002 issue of *General Dentistry* and written by Drs. Polly S. Nichols and Gerald R. Winslow. Eleven judges participated in the review process. Their names are listed among the Journal reviewers below. The Cronbach alpha for consistency among the judges was an extremely high .944.

The College thanks the following professionals for their contributions, sometimes multiple efforts, to the dental literature as reviewers for the *Journal of the American College of Dentists* during 2003.

Phyllis Beemsterboar, PhD  
Portland, OR

Reynolds R. Chelloner  
Luxemburg, WI

James R. Cole, II, DDS, FACD  
Albuquerque, NM

Steve Corbin, DDS, MPH, FACD  
Rockville, MD

Eric K. Curtis, DDS, FACD  
Safford, AZ

Charles D. Dietrich, DDS, FACD  
Washington, DC

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Canton, OH

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## *Journal of the American College of Dentists* 2003 Statement of Ownership and Circulation

The *Journal of the American College of Dentists* is published quarterly by the American College of Dentists, 839J Quince Orchard Boulevard, Gaithersburg, Maryland 20878-1614. Editor: David W. Chambers, EdM, MBA, PhD.

The American College of Dentists is a non-profit organization with no capital stock and no known bondholders, mortgages, or other security holders. The average number of readers of each issue produced during the past twelve months was 5344, none sold through dealers or carriers, street vendors, or counter sales; 5244 copies distributed through mail subscriptions; 5263 total paid circulation; 147 distributed as complimentary copies. Statement filed with the U.S. Postal Service, September 20, 2003.

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