



National Institute of Dental
and Craniofacial Research



STRATEGIC PLAN

2014–2019

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
National Institutes of Health

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FROM THE DIRECTOR



The oral health of Americans has improved dramatically in the past half-century. These gains are due in large part to research and research training supported by the National Institute of Dental and Craniofacial Research (NIDCR). Today, the fruits of this research investment enable us to understand human biology like never before. Our challenge is to ensure that new knowledge and technologies are used strategically and quickly to yield evidence-based, individualized oral health care. Our approach must be comprehensive and collaborative across multiple research and health care disciplines.

NIDCR maintains a varied and productive research portfolio of basic investigations in molecules and cells; animal, tissue, and computer models that interrogate human disease; and clinical studies with individuals, communities, and populations in the United States and abroad. To chart the Institute's course for the next six years through strategic planning, we engaged in a process of introspective analyses and consultation with our stakeholders. As an Institute with an expansive agenda, we seek innovative solutions to a broad array of health problems and to probe the mysteries of biomedicine as they relate to the NIDCR mission.

The NIDCR Strategic Plan for 2014-2019 embraces the multidisciplinary essence of dental, oral, and craniofacial health and the research that informs its evidence base. The plan centers on four key goals:

Let Science Drive. We will support the best basic, translational, clinical, and community-based research to build a strong evidence base in dental, oral, and craniofacial health. Doing so will help bridge the gap between research and health care practice for improved human health. Our first strategic goal affirms the basic tenet that rigor and reproducibility of experimental design and results are essential elements of scientific investigation.

Enable Precise and Personalized Oral Health Care. As trusted providers of health care, dentists and physicians have long recognized variations among patients and have provided personalized care based on the many biological and behavioral components that shape health. NIDCR-supported research can help enhance personalized health care in two ways. We will encourage better integration between health-related researchers and health care providers, and we will work to identify influences on oral health at the molecular level through biomarker discovery and the development of risk-assessment tools.

Address Oral Health Disparities. NIDCR's involvement in oral health disparities research is a long-term, deliberate investment. It focuses on building a foundation of knowledge that has had, and will continue to have, a measurable impact on clinical practice, public policy, and the oral health of many of the nation's most vulnerable populations. Although our commitment to eliminating oral health disparities is steadfast, it will continue to take time to reach fruition. This strategic goal signifies the importance of sustained effort that requires collaboration with many partners in government and industry, and with a range of organizations and individuals in communities.

Engage a Diverse Oral Health Research Workforce. Our fourth strategic goal applies to all areas of this strategic plan. It articulates the notion that people — scientists and practitioners, individuals and communities — are the lifeblood of biomedical research. Innovation and problem-solving require a workforce that is multidisciplinary and inclusive of scientists from diverse backgrounds and life experiences. Promoting education, scholarship, and training at all levels and types of institutions — from students to laboratory investigators to health care providers — helps ensure that evidence-based care reaches patients and communities. Novel and collaborative strategies to engage a diverse oral health research workforce and to disseminate evidence-based information will guide us through the highly dynamic landscape of 21st century biomedicine.

There has never been a better time to take advantage of the remarkable opportunities in science and technology waiting at our doorstep. Seizing this moment brings us closer to preventing and treating dental, oral, and craniofacial conditions as well as other diseases that share risk factors and therapeutic strategies.

I welcome your continued input as we strive to revolutionize oral health through research.

Martha J. Somerman, D.D.S., Ph.D.

Director, National Institute of Dental and Craniofacial Research

Discover – *Enable the best science to solve problems in dental, oral, and craniofacial health.*

Integrate – *Promote the convergence of science, health care, and the research workforce toward ensuring that oral health is integral to overall health.*

Collaborate – *Partner with individuals and organizations within and outside dentistry, government, and academia, to improve the nation's dental, oral, and craniofacial health.*

NIDCR MISSION

The mission of the National Institute of Dental and Craniofacial Research (NIDCR) is to improve dental, oral, and craniofacial health through research, research training, and the dissemination of health information.

We accomplish our mission by:

- Performing and supporting basic, translational, 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; and
- Promoting the timely transfer of knowledge gained from research and its implications for health to the public, health professionals, researchers, and policy-makers.



“The National Institute of Dental and Craniofacial Research will be recognized as a catalyst for transforming how oral health care is delivered. This includes a more comprehensive integration of basic, clinical, and population science to devise new tools and approaches to improve oral health.”

—Dr. Martha Somerman, NIDCR Director



NIDCR STRATEGIC PLAN 2014–2019

This strategic plan articulates four goals: supporting excellent science, embracing the value of precise and personalized oral health, reducing oral health disparities, and ensuring a strong and diverse workforce. These goals and their supporting objectives will guide NIDCR's decision-making for the next six years toward achieving a balanced research portfolio that improves the nation's dental, oral, and craniofacial health.





GOAL ONE

1

Support the best science to improve dental, oral, and craniofacial health.

Biomedical and behavioral research provides knowledge to support the ever-evolving practice of health care. This scientific base requires a broad array of research strategies to help us understand the fundamental causes of diseases and to transform that knowledge into a lifetime of better health for people everywhere. Most dental, oral, and craniofacial conditions arise from complex interactions of biological, behavioral, environmental, and higher system-level factors. Thus, NIDCR-supported research must involve a breadth of approaches including biological mechanistic and interventional studies, behavioral and social sciences, public health research, population-health studies, clinical trials, and community-based studies.

OBJECTIVE 1–1

ENABLE BASIC RESEARCH TO ADVANCE KNOWLEDGE OF DENTAL, ORAL, AND CRANIOFACIAL HEALTH.

The diverse and interactive group of cells and tissues that make up the dental, oral, and craniofacial complex provides a powerful system for discovery research. Recent advances in technology offer exciting opportunities to examine these cells and tissues, *in vitro* and *in vivo*, and to develop precise clinical tools for risk assessment, screening, prevention,

diagnosis, and treatment of various oral diseases. Several areas of research poised for rapid growth are mentioned below. However, NIDCR remains committed to supporting all areas of science relevant to its broad mission through its intramural and extramural research investments.

The complexity of the oral and craniofacial regions presents special opportunities to investigate basic mechanisms of cell biology such as growth and development, differentiation, stem-cell function, and regeneration. NIDCR investments will focus on defining the molecules and pathways that contribute to development, maintenance, and remodeling of dental, oral, and craniofacial tissues. The goal of these efforts is to develop predictable materials, factors, and delivery systems to sustain and restore tissues and organs of the dental, oral, and craniofacial complex. Two emerging areas of great promise include the study and application of epigenetics and tissue engineering.

NIDCR will continue to support fundamental oropharyngeal cancer research that will enable risk assessment, prevention, early identification, and treatment of this disease that currently takes a life every hour in the United States and is a serious problem worldwide. In addition to basic studies of the biology of oral cancer and of tumor immunology, NIDCR will encourage research building on its support of the Oral Cancer Genome Project, with the goal of guiding the shift toward precise diagnosis

NIDCR invests in rigorously designed biomedical and behavioral research studies that drive science forward. NIDCR will serve a leadership role by promoting the use of common quality standards so that basic, translational, and clinical investigators achieve sufficient sample sizes and use consistent measures and data sets. Resonant with comparable trans-NIH efforts, the Institute will collaborate further with the scientific community and other stakeholders on efforts to ensure scientific rigor and the reproducibility of research results.

NIDCR Intramural Scientists Explore Taste, Smell, and Itch

For many years, NIDCR-funded research has made formative contributions to the field of sensory biology, in particular taste and smell. These two chemical senses play a significant role in perceiving the external world, and they are also important control points for feeding behavior that affects a huge array of oral and other health conditions.



As a senior investigator in NIDCR's intramural research program, **Nicholas Ryba, Ph.D.**, has spent more than two decades untangling the fundamental underpinnings of taste and smell. Throughout this period, Ryba has maintained a model collaborative spirit through longstanding scientific relationships with academic partners as well as with other researchers on the NIH campus. In particular, Ryba and Charles Zuker, Ph.D., of Columbia University in New York have worked together to define how the sense of taste detects and distinguishes specific qualities. In wide-ranging studies, they have mapped the pathways responsible

for sweet, bitter, salty, sour, and savory taste — from the surface of the tongue to the depths of the brain.¹ Their work has revealed that “good” and “bad” tastes are largely innate and genetically specified to influence eating and other behaviors.

Our sense of smell is of course intimately linked to taste and plays an even more important role in food-choice than the sense of taste itself. But studying the sense of smell may also help us understand brain disorders. For example, Ryba's group recently generated genetically altered mice with such a heightened ability to perceive specific odors that these smells triggered powerful seizures.² The results add to our knowledge of how smell is sensed as well as provide new avenues for studying epilepsy.

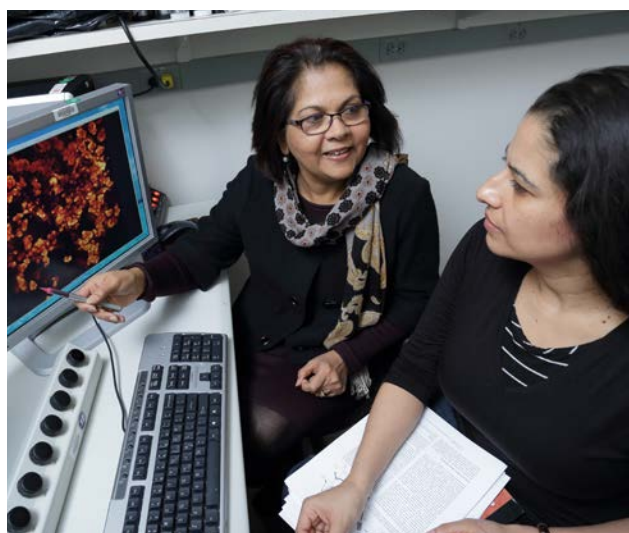


Recent findings from NIDCR-supported intramural scientists also shed new light on itch and pain. By examining neuropeptides, transmitters that convey information between nerve cells, **Mark Hoon, Ph.D.**, discovered that one of these molecules is required for the sensation of itch and that another molecule is responsible for sensing certain types of pain.³ Hoon and his team found that genetically altered mice in which the itch-related molecule had been removed could not sense all of the itch-inducing agents the researchers tested. In another surprise, the scientists found that, unlike previously thought, the itch pathway

is independent of other sensations, such as temperature, pain, and touch. Hoon is now looking to see if the human nervous system communicates the perception of itch the same way as the mouse nervous system does. If such similarities exist, they provide a promising target for drugs to provide relief to the millions of people with chronic itch conditions, such as eczema and psoriasis. Studies are also ongoing to understand more about the mechanism by which pain signals are detected.

and individualized disease management. One area of special focus will be human papillomavirus (HPV)-associated oropharyngeal cancer, the incidence of which is on the rise.^{4,5}

NIDCR will support novel basic, clinical, and translational research projects on the many infectious conditions affecting the oral cavity, ranging from caries to HIV/AIDS and HPV. The Institute will continue research on oral mucosal and innate immunity toward the development of a prophylactic HIV vaccine delivered through the oral mucosa. Other areas of research interest related to HIV/AIDS include the role and formation of viral reservoirs in oral cells and tissues, improved animal or cellular models to study host-virus interactions in the oral cavity, and identification of targets for point-of-care diagnostics and new therapies to treat HIV/AIDS and associated oral opportunistic infections and malignancies. Engaging in research with people living with HIV may offer new insights into identifying risk factors and for prevention and treatment of AIDS co-morbidities.



The Institute's continued investment in salivary gland research will extend general understanding of secretory organs as well as specific knowledge regarding health problems such as dry mouth and its oral complications, and salivary gland cancers. Knowledge gained through this research will be used to prevent and treat salivary gland dysfunction resulting from Sjögren's syndrome or irradiation-induced salivary gland damage from head and neck cancer treatment. Encouraging research toward the identification and validation of predictive biomarkers in

saliva for a variety of oral and systemic diseases will benefit disease screening and monitoring since, as a diagnostic fluid, saliva has many advantages over blood.^{6,7}

NIDCR will be a leader in supporting the development of specialized tools for advancing knowledge about dental, oral, and craniofacial health, including, but not limited to, single-cell methods, stem-cell systems, multiscale imaging modalities, and disease models that accurately represent human biology. Examples of current technologies resulting from NIDCR investment include lab-on-a-chip devices, point-of-care oral health applications, and intravital microscopy.^{8,9} The Institute will continue to fund the Federal Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programs¹⁰ to support research on products and devices ready for clinical testing and commercialization.

New Opportunities to Track Oropharyngeal Cancer

Human papillomavirus (HPV) infects human cells in mucous membranes, and distinct viral strains cause cervical cancer or oropharyngeal cancer.^{11,12} Most people exposed to HPV never develop cancer, but a subset of those exposed develop a persistent infection that leads to cancer. Current reports state that the incidence of HPV-associated oropharyngeal cancer more than tripled from 1988 to 2004,¹³ calling for continued research to understand why this increase occurred and to develop effective methods to stem the rise through population-health approaches. Because of underlying immunosuppression, a higher risk of HPV-associated oropharyngeal cancer is present in people infected with HIV.¹⁴

HPV-associated oropharyngeal cancers differ markedly from non-HPV oropharyngeal cancers. Survival rates for the two types are dramatically different: people with HPV-associated oropharyngeal cancer have far better survival rates than people with non-HPV oropharyngeal cancer. The two cancers are also different at the molecular level and respond differently to treatments, indicating that they are by most accounts completely separate diseases. But scientists need to learn much more about HPV-associated oropharyngeal cancer, and NIDCR-supported research is actively pursuing questions related to incidence, risk factors, and disease progression. Researchers have identified a sex-based difference in the prevalence of oropharyngeal HPV infection, with three-fold higher infection rates in men compared to women.¹⁵ Smoking is also an independent risk factor for oropharyngeal HPV infection — potentially due to mutagenic or immunosuppressive effects.

Many questions remain, but the FDA-approved HPV vaccine Gardasil¹⁶ is effective against infection with the particular strains of HPV implicated in oropharyngeal cancers. A recently published National Cancer Institute-funded clinical trial of 5,840 women demonstrated that another HPV vaccine, Cervarix, was highly effective at preventing oral HPV infection in women with or without HPV cervical infections.¹⁷ While it has not been established that currently approved HPV vaccines can prevent oral cancer, NIDCR remains vigilant to this public health opportunity for cancer prevention and will encourage research to fill gaps in understanding.

For example, an NIDCR-funded STTR grant enabled the development of a new disinfecting system for polyurethane tubing used in dental water lines. The project involves attaching selenium to the inside of the tubing, which blocks bacterial attachment. Currently, the investigator is developing a selenium-coating process that can be used commercially and will then test the product in dental-practice settings. If successful, the system could be used to address problematic waterline contamination. This STTR investment also has led to a new line of products with antimicrobial properties.

OBJECTIVE 1–2

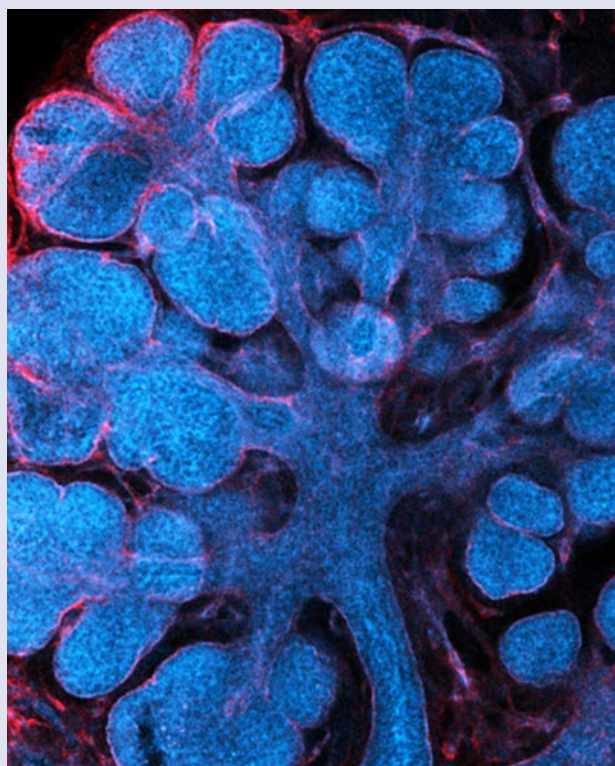
PROMOTE DEVELOPMENT AND USE OF COMPREHENSIVE, INTEROPERABLE DATABASES AND INFORMATICS RESOURCES TO ADVANCE PREVENTION, DIAGNOSIS, AND TREATMENT OF DENTAL, ORAL, AND CRANIOFACIAL DISEASES.

Modern biomedicine is, to a large extent, an information science. Rapid advances in both computing and communications have enabled the collection, storage, and retrieval of massive amounts of biomedical data and knowledge. In turn, large-scale analyses of interactions among genes, proteins, and many other biomolecules, often referred to as ‘omics approaches, have become not only feasible, but commonplace. Further development

of data management, mining, and integration tools and enhanced access to and use of comprehensive, semantically interoperable databases and resources will facilitate future biomedical research and improve clinical practice and health-science education. The Institute recognizes a particular need for development of adequately sized databases containing oral phenotypes; these resources can help strengthen understanding of gene-environment interactions as well as tease apart subtypes of disease. NIDCR is committed to contributing to and exploiting the depth and breadth of 21st-century ‘omics investigations as well as to effectively and efficiently mining the rich datasets, often termed Big Data, that these methods produce.

The NIH Common Fund¹⁸ was established as an incubator for catalyzing transformative research relevant to all NIH Institute and Center missions, but specific to none. NIDCR will take advantage of the resources and opportunities available through the NIH Common Fund’s Big Data to Knowledge initiative.¹⁹ This important initiative involves all NIH Institutes and Centers and aims to make Big Data and data science more prominent components of all biomedical research. To build on the success of another Common Fund ‘omics initiative, the trans-NIH Human Microbiome Project,²⁰ NIDCR will build

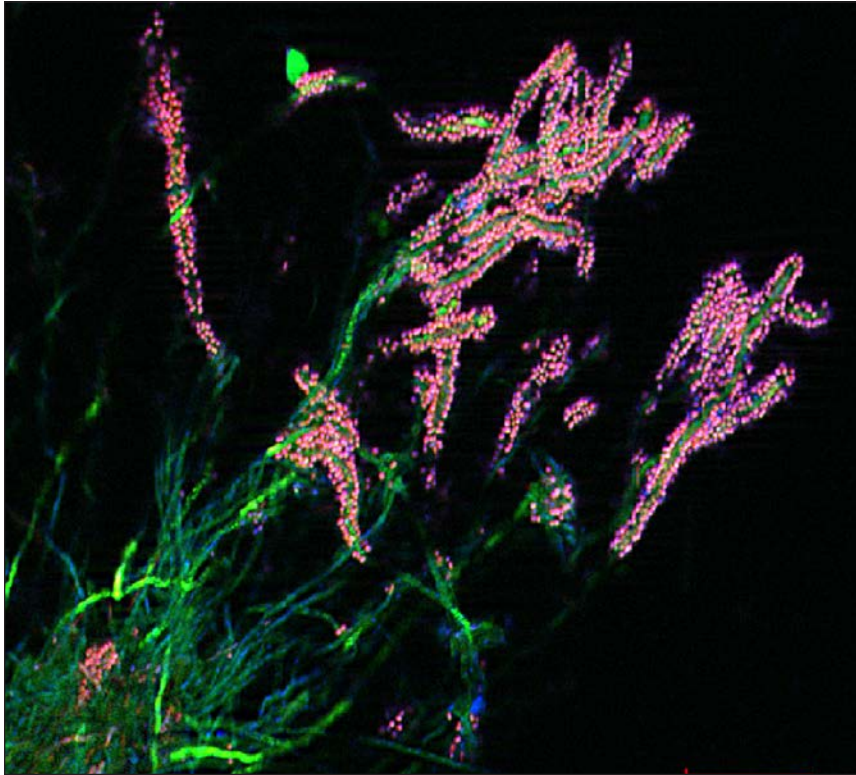
Salivary Gland Tumor Biorepository



Salivary gland cancers are rare, with only a few thousand new cases in the United States each year.²¹ They also are often fatal. Research progress has been slowed by the fact that the rarity of this cancer type means that there are few tumor samples available for researchers to study. To address this need, and to encourage salivary gland cancer investigation by more scientists from other disciplines, NIDCR supported a centralized salivary gland tumor biorepository in 2009 through a contract to the University of Texas MD Anderson Cancer Center.²² This effort was driven by a series of workshops co-sponsored by NIDCR and the Adenoid Cystic Carcinoma Research Foundation (ACCRF), which highlighted the need for centralized and accessible biological samples, including authentic cell lines.

This project has relied on expertise and materials from many sources, in particular the input of the ACCRF. Leading the biorepository effort today is MD Anderson Cancer Center's Adel El-Naggar, M.D., Ph.D., a nationally and internationally recognized expert in salivary gland cancer biology and among the most prominent head-and-neck pathologists in the world. Other contributing centers include Johns Hopkins Medical Institution, Rhode Island Hospital, the University of Virginia, the University of Pittsburgh Medical Center, and the University of Mississippi Medical Center.

In addition to facilitating resource sharing, the effort has another important goal: data standardization. By carefully monitoring and controlling collection of tumor samples and related clinical information, the biorepository can minimize variability among research groups. The resource serves the needs of clinical researchers as well as basic scientists by generating cell lines from primary tumor tissues and cataloging and storing cells, biofluids, and tissues in a centralized facility. A robust database is a central feature of the biorepository. It tracks collection, storage, distribution, and usage of biospecimens and cell lines.



on the knowledge resulting from the Human Oral Microbiome Database that is allowing scientists to better understand the interplay among host, microorganisms, health, and disease (see “The Unexplored Microbial Universe in Our Mouths,” page 15).²³ The Institute will encourage research that defines both overlapping and unique roles of the oral microbiota, not only in oral-related illnesses such as dental caries and periodontal diseases, but also as mechanistic contributors to immune function and other disorders.

By funding genomic research, such as genome-wide association studies (GWAS) and DNA-sequencing studies, NIDCR underscores the utility of systems approaches for interrogating oral health biology. Previous GWAS of dental caries identified genetic variants associated with dental caries history and suggested interplay between genes, home fluoride exposure levels, and in some cases, taste.²⁴ Other results from NIDCR-funded genomic research have identified genetic risk factors for cleft lip with and without cleft palate in Asian and European ancestry populations, pointing to new research, prevention, and treatment avenues.^{25,26} The Institute encourages genomic research that will enrich these findings as well as identify risk factors for other dental, oral, and craniofacial disorders and other complex disorders such as Sjögren’s syndrome, chronic pain, oral cancer, and others.

NIDCR will sustain the national FaceBase Consortium²⁷ that is designed to provide resources to the craniofacial research community to better understand the genetic instructions controlling development of the middle region of the human face. NIDCR

The Unexplored Microbial Universe in Our Mouths

Not unlike early astronomers exploring the heavens, biomedical scientists are increasingly astounded by the vastness and complexity of microbial life in the human body. By the numbers, we are more bacterial than human, and by a long shot — about 10 bacteria to every one human cell — although single-cell microorganisms are much, much smaller than our own. Understanding more about the bacteria that call us “home,” the human microbiota, is a matter of intense interest in the scientific community, since many health conditions have been directly or indirectly linked to specific bacterial types as well as bacterial neighborhoods that vary substantially from person to person, and within the same individual under different conditions and physiological circumstances.

Exploring and characterizing the human oral microbiota is at once a huge opportunity and an immense challenge. We know that host oral tissues and fluids have remarkable protective roles that are also affected by the particular population of resident bacterial species in the host. We also know from NIDCR-supported research that about 600 unique microbial species populate the oral cavity. Less than half of these species can be cultivated using conventional laboratory conditions.²⁸

The NIDCR-supported open access Human Oral Microbiome Database aims to break open this complexity by promoting distribution of genetic, phenotypic, clinical, and bibliographic data for unnamed and uncultivated members of the oral microbiota.²⁹ This resource, along with new methods to study uncultivable oral microbiota, will accelerate translation of basic discoveries to tomorrow’s clinical breakthroughs.

What types of practical applications might benefit the most? Complex infectious oral diseases, such as early childhood caries and destructive periodontal diseases, could serve as models of polymicrobial disease. More broadly, this research will extend the foundation of existing microbiome research to explore and map an exciting new frontier in oral microbiology. The goal of the Human Oral Microbiome Database is to provide the research community with direct access to DNA-sequence information for the hundreds of species of organisms that are present in the human oral microbiota, many of which were previously uncultivable, enabling a deeper understanding of the role of bacteria, viruses, and fungi in immune function. Importantly, NIDCR believes that this research investment will yield novel approaches to study the function of the uncultivable oral microbiota, fostering hypothesis-driven basic research, and supporting the translation of new discoveries to targeted and improved prevention, diagnosis and early treatment.

promotes the scientific community's collaboration across geographic and disciplinary lines in this national network that collects, integrates, and disseminates data on craniofacial development and disorders. NIDCR will broaden and deepen its support of the FaceBase resource by generating and disseminating datasets not covered in the launch phase of the consortium. These may include data describing additional areas of the developing face or skull; novel informatics methods for integrating, visualizing, and analyzing FaceBase data; and face-related research tools arising from studies in model organisms.

OBJECTIVE 1–3

CONDUCT TRANSLATIONAL AND CLINICAL INVESTIGATIONS TO IMPROVE DENTAL, ORAL, AND CRANIOFACIAL HEALTH.

NIDCR will maintain its support of clinical research that advances knowledge and leads to better patient care outcomes. In partnership with the scientific, clinical, and patient advocacy communities, NIDCR will continue to develop and refine the Institute's clinical research agenda that focuses on the most pressing public health needs that would benefit

from new prevention, early detection, and improved treatment approaches (see "NIDCR-Funded Clinical Studies," page 25, for current examples of NIDCR-funded clinical research).

NIDCR will support an array of study designs to resolve clinical questions, including, but not limited to, randomized controlled trials, qualitative and mixed-methods research, community-based participatory research, cohort studies, secondary data analyses, and comparative effectiveness research. The Institute will encourage research on technologies for clinical risk assessment and diagnosis. It will also partner with other Federal agencies and public and private organizations to adopt comprehensive electronic health-record, history, and treatment information models as clinical research tools.

NIDCR will encourage the use of large health datasets developed and maintained by both government³⁰ and non-government organizations and it will leverage existing clinical research infrastructure supported by other NIH Institutes and Centers. One important resource is the NIH Clinical and Translational Science Award (CTSA) program, which aims to accelerate translation of laboratory discoveries into treatments for patients, to engage communities in clinical research studies, and to train a new generation of clinical and translational researchers.³¹ Expanding current CTSA oral health collaborations to others in the oral health research community will enrich this national



health research program. Academic health centers, where CTSA are housed, offer many resources that can augment the training of dental researchers and those from fields such as nursing, behavioral and social sciences, biostatistics, and epidemiology — moving toward a more translational research orientation and facilitating multidisciplinary and interdisciplinary research interactions. The NIH Clinical Center has also extended the availability of clinical research resources to NIH-funded extramural grantees.³²

An essential companion effort to supporting the highest-quality dental, oral, and craniofacial basic, translational, and clinical research is maintaining and sharing the knowledge this research builds. The oral health evidence base constructed through NIDCR's biomedical and behavioral research provides important information for the nation's practice community. Working with professional organizations and societies, especially dental groups, NIDCR will increase efforts to raise awareness of the importance of evidence-based decision-making in clinical dental practice as well as the importance of empowering patients in managing their own care. This will be accomplished in part through the National Dental Practice-Based Research Network³³ (see Goal IV, Objective 2, page 42), as well as through dynamic modes of communication including social media.

OBJECTIVE 1–4

MAINTAIN THE ROLE OF NIDCR AS A TRUSTED SOURCE OF INFORMATION AND EVIDENCE RELATED TO DENTAL, ORAL, AND CRANIOFACIAL HEALTH.

Enhancing oral health surveillance capability in the United States is a cornerstone of enabling evidence-based decision-making in clinical practice. In partnership with organizations including NIH Institutes and Centers, the Centers for Disease Control and Prevention (CDC), and other Federal agencies, NIDCR will continue to support collection, analysis, and dissemination of oral health data to be used for surveillance and population-based research, as well as to inform public health practice and the development of public policy.

The Institute will encourage development and validation of self-reported and real-time data collection and new methods to measure and document oral diseases, disorders,



and conditions. Working with stakeholders including public and private sector organizations, NIDCR will encourage the systematic study of practice patterns, professional trends, and other factors that can stimulate research aimed at improving oral health care quality, access, and delivery.

Although national surveys are good sources of population health data, they do not always reflect the diversity of the U.S. population.³⁴ NIDCR has partnered with NIH's National Heart, Lung, and Blood Institute and six other NIH components to sponsor a multicenter epidemiologic study in Hispanic/Latino populations. The Hispanic Community Health Study/Study of Latinos,³⁵ the largest study of Hispanics ever undertaken by NIH³⁶, will determine the prevalence of specific chronic conditions in four urban-dwelling Hispanic populations, associated risk factors for certain diseases, and the role of acculturation on Hispanic/Latino health. Importantly, the study includes Hispanics of different origins, providing the first opportunity since the 1980s to comprehensively examine the oral health of Latino sub-groups. NIDCR will continue to develop opportunities to support the collection of oral health data within large epidemiologic

studies of groups whose health needs and epidemiologic profiles are not well captured in nationally representative data. Studies and analyses of groups within groups will likely shed important light on causes and consequences of disparities related to culture and other factors.





GOAL TWO

2

Enable precise and personalized oral health care through research.

Revolutionary changes in health care are on the horizon, driven by advances in technology and a remarkable convergence of knowledge spanning diverse fields of science. The oral health community must embrace personalized, precision health care in the near term, and NIDCR is committed to being at the leading edge of this development.

As we understand more about signaling pathways, molecular interactions, and novel biomarkers that underlie health and disease, the dental, oral, and craniofacial complex stands out as a unique gateway to assess risk, prevent and diagnose disease, and guide treatment. For example, the complex can be easily accessed and repeatedly sampled for caries development, periodontal disease, saliva, biofilm-related microorganisms, and mucosal tissue — often with minimal pain or difficulty. Science is converging naturally according to common, underlying biological principles, and NIDCR will adapt by establishing firmer connections that reflect these commonalities between oral and general health care practices.

OBJECTIVE 2–1

SUPPORT RESEARCH TOWARD PRECISE CLASSIFICATION, PREVENTION, AND TREATMENT OF DENTAL, ORAL, AND CRANIOFACIAL HEALTH AND DISEASE.

Ongoing analyses of genomic information in many fields of biomedicine are uncovering new approaches for diagnosing and managing disease based on molecular signatures, rather than relying mainly on symptoms and clinical assessment. NIDCR will continue its support of research toward the development of user-focused, point-of-care technologies that detect dental, oral,

and craniofacial health problems in a range of diverse settings, including underserved, low-resource communities nationwide and internationally. This is a first step toward developing effective and personalized disease-management strategies.

NIDCR will support an array of complementary research projects pertaining to physical, functional, and biochemical indicators of disease, including biomarkers — especially those with potential utility for clinical practice. Already in progress is an NIDCR-supported research project that recently yielded a miniaturized, portable nanobiochip that uses nanoliter volumes of saliva to identify biomarkers for a multitude of diagnostic purposes.³⁷

Progress toward the development of personalized and precision health care requires intensive, interdisciplinary research collaborations, and NIDCR will vigorously encourage the establishment of such team efforts. In partnership with stakeholders and other NIH units with relevant interest and expertise, the Institute will foster the development and validation of imaging techniques that promise to increase risk-assessment accuracy for treatment of dental, oral, and craniofacial diseases and disorders. In particular, NIDCR will encourage focused research on specialized imaging and other technologies to trace both physiological and pathological pathways and processes, recruiting needed expertise from quantitative disciplines such as engineering, computer science, materials science, and physics. NIDCR will continue to support efforts to facilitate reconstruction and regeneration of diseased or damaged oral and craniofacial tissues and organs through biological, chemical, bioengineering, and biomaterials research approaches.

The oral cavity is a key entry point for both healthful nutrients and pathogens. Its accessibility and cellular and tissue complexity enable development of novel drug delivery systems for the dental, oral, and craniofacial complex, as well as for other areas of the body such as the lungs or intestinal tract. NIDCR will encourage basic and clinical research to determine the specificity and effectiveness of orally administered substances for manipulating various physiological processes with precisely controlled release kinetics.

Body: Heal Thyself

What if a damaged tooth or diseased gingiva — or a broken jaw — could heal itself quickly and effectively with a natural repair kit delivered promptly to the injured or diseased site? This could someday soon become reality as a result of impressive progress in NIDCR-supported research that aims to understand how to use natural physiological processes as therapies. Two examples are immune-system modulation that redirects potentially harmful inflammation and the use of stem cells in regenerative medicine approaches.

One promising application for the development of such natural repair kits is periodontal disease, which is a group of conditions that affect the periodontium, the collection of specialized tissues that surround and support teeth and connect them to the bones of the face. Periodontal disease is a health issue affecting one-half of American adults.³⁸ It is characterized by red, swollen, and painful gingiva, and in severe cases, bone destruction. It is caused by constant exposure to a microbial community called a biofilm, which envelops the teeth and gingiva. When immune cells attack bacterial invaders in the mouth, an over-exuberant response can result in persistent inflammation that progressively degrades soft tissue and bone.

NIDCR-funded scientists are learning the step-by-step process that immune cells and natural substances use in the periodontium, and they are devising ways to interrupt or deliberately change it to control inflammation that can be problematic when unchecked. For example, researchers working with a mouse model of periodontal disease developed a system of polymer microspheres that slowly release a substance that attracts T-regulatory immune cells to injured or diseased oral tissue.³⁹ These T cells are often absent at diseased sites, and re-introducing them allows them to act like local police toward other immune system components, tamping down inflammation and limiting the breakdown of bone, leading to natural healing.

Other NIDCR-funded research on natural repair involves a group of substances called lipoxins. The body creates these and other similar molecules called resolvins naturally from fatty acids, and their production is enhanced in the presence of aspirin.⁴⁰ Studies in animal models have shown that lipoxins reduce cellular inflammation better than current non-opioid pain relievers, and resolvins also appear to have bone-preserving properties.⁴¹ A lipoxin rinse is currently being developed by NIDCR-funded scientists as treatment for gingivitis and the first human studies are planned.

Harnessing the regenerative properties of stem cells, other NIDCR-funded scientists are testing the ability of mesenchymal stem cells, or MSCs, to re-grow bone damaged by craniofacial disease or injury.⁴² MSCs in oral tissues have the ability to become bone, cartilage, or fat, depending on the body's needs. Researchers are also using MSCs taken from gingiva and bone tissue to study wound healing and scar formation, as well as to investigate the complex interactions between immune cells in the mouth and various oral structures.

OBJECTIVE 2–2

ENGAGE PRIMARY CARE PROVIDERS AND HEALTH SPECIALISTS TOWARD INDIVIDUALIZED, EVIDENCE-BASED HEALTH ASSESSMENT, DISEASE PREVENTION, AND TREATMENTS.



Personalized oral health must encompass interactions between individuals and their health care providers, families, and communities, as well as the roles played by the health care system. NIDCR will increase efforts to integrate oral health into the broader body of health research initiatives and facilities, as well as within overall clinical care infrastructures. NIDCR will encourage multidisciplinary and transdisciplinary⁴³ interactions among providers within Federally Qualified Health Centers⁴⁴ and other community-based settings, as well as in non-traditional patient-care settings. The Institute also supports research to determine ways to enhance patient-provider communication, which may have numerous health benefits for individuals and families.

Poor oral health often co-occurs with other health conditions such as obesity, mental illness, substance abuse, and injury/trauma.^{45,46} NIDCR

will support multidisciplinary research to determine contributions to oral health from common disease risk factors. These include unhealthy diet, poor hygiene, tobacco and alcohol use, stress, poverty, and lack of access to dental and general health care.

NIDCR-Funded Clinical Studies

NIDCR funds extramural and intramural clinical research that addresses a range of scientific questions related to the Institute's mission.

Selected examples include:

- Assess fluoride treatment of dental decay with polarization-sensitive optical coherence tomography
- Define biomarkers of periodontal disease progression
- Characterize suspicious oral lesions using novel lab-on-a-chip ensembles
- Investigate genetic mutations causing amelogenesis imperfecta, dentinogenesis imperfecta, or dentin dysplasia
- Identify genetic factors contributing to oral health disparities in Appalachia
- Conduct genetic studies of temporomandibular disorders (TMD)
- Image early-carries lesions with near-infrared light
- Define immune control of Kaposi's sarcoma-associated herpesvirus infection
- Determine mechanisms and treatment response of aggressive periodontitis in children
- Determine the natural history of cracked teeth (a National Dental Practice-Based Research Network study)
- Define the perivascular niche for salivary gland cancer stem cells and their resistance to therapy
- Predict caries risk in underserved toddlers in primary health care settings
- Estimate the prevalence of oral human papillomavirus (HPV) infections in the United States
- Determine the role of HPV in head and neck squamous cell cancer
- Establish the safety and feasibility of administration of DNA vaccine in HPV-16 associated head and neck cancer patients
- Investigate single-suture craniosynostosis
- Investigate factors associated with the onset and transition from acute to chronic TMD





OBJECTIVE 2–3

PARTNER WITH PUBLIC AND PRIVATE ORGANIZATIONS TO IMPROVE ORAL HEALTH.

As an NIH component with an expansive mission, NIDCR will pursue opportunities to partner with stakeholders in areas that will help advance the Institute’s goals toward tailoring oral health for individuals, groups, and communities. In particular, these areas will include i) expanding communication among research, practice, educational,

advocacy, and public health communities, ii) developing and commercializing products, and iii) addressing global health challenges.

NIDCR will participate in all trans-NIH opportunities that influence advancement of oral health research and research training. The NIH Common Fund will enable NIDCR to extend its reach into efforts related to workforce growth and diversity, basic behavioral and social sciences, ‘omics science, computational biology/informatics, and other areas. As a member of the NIH Pain Consortium,⁴⁷ NIDCR will promote its pain research agenda via collaboration among researchers across the many NIH Institutes and Centers that have programs and activities addressing pain (see “NIDCR Research Addresses the Many Faces of Pain,” page 27).

NIDCR Research Addresses the Many Faces of Pain

According to the 2011 Institute of Medicine report “Pain in America,” chronic pain costs the United States up to \$635 billion each year in medical treatment and lost productivity.⁴⁸ To anyone who has either experienced chronic pain or knows someone who has, the costs are truly immeasurable. A multitude of conditions cause chronic pain. These include chronic fatigue syndrome, endometriosis, fibromyalgia, interstitial cystitis, irritable bowel syndrome, chronic headache, temporomandibular disorders, or TMD, and vulvodynia. For reasons that are not thoroughly understood, all of these conditions exact a bigger toll on women than on men. Often an injury or health problem like an infection triggers short-term, or acute, pain, which can then transform into a years- or even decades-long health nightmare. Why do some pain conditions, and not others, turn into longstanding problems? Which treatments work for short- and long-term pain, and can anything be done to mitigate the suffering of millions of Americans?

NIDCR has been a long-time supporter of research on pain in general, and on specific painful oral conditions such as TMD, a group of conditions that can cause intense jaw and facial pain. Common TMD symptoms include pain from chewing or in the jaw joint, limited jaw opening, painful clicking, and popping or grating in the jaw joint when opening or closing the mouth. Research has shown that people with TMD also often have other, related chronic painful conditions such as fibromyalgia and irritable bowel syndrome. Scientists suspect that the overlap of chronic pain conditions is not coincidental, and they are looking for common features in the susceptibility, severity, and progression of various chronic pain conditions — with the twin goals of understanding the cause of pain and determining treatments effective for several conditions at once.

NIDCR supports a wide range of basic research investigating how pain begins as well as studies focused on determining novel ways to treat pain, including non-opioid analgesics that control inflammation. NIDCR also collaborates extensively with the NIH community to tackle the problem of chronic pain by co-funding a range of multidisciplinary and interdisciplinary basic and clinical research approaches. The seven-year Orofacial Pain: Prospective Evaluation and Risk Assessment (OPPERA I) study aimed to identify causes of first-onset TMD. The results, published in 2013, indicate that a broad range of factors such as sociodemographics, health status, clinical orofacial factors, psychological function, and pain sensitivity influence the course of TMD.⁴⁹ The follow-up study, OPPERA II, will identify risk factors that predict whether acute TMD will transition into a chronic condition. OPPERA II will also identify genetic aspects and other risk factors that determine whether acute TMD will develop as a single condition or in conjunction with other chronic pain conditions, including headache, low back pain, irritable bowel syndrome, and widespread body pain.⁵⁰

Public transparency in NIDCR's research activities is mutually beneficial for the Institute and its stakeholders, adding diverse perspectives and building both understanding and trust. NIDCR will continue to enhance its digital media capabilities with the use of online resources and social media to foster relationships with the public, grantees, and funding/policy collaborators. In November 2013, NIDCR teamed with the Delta Dental Plans Association and the Institute for Oral Health by hosting the symposium "Science and Dentistry in Action: Leading the Way Towards Better Health." The meeting launched an effort to bring research and clinical practice communities together for interactive learning and discussion of current areas of science and practice. NIDCR will conduct similar activities that encourage learning and relationship-building on an ongoing basis.

A key aspect of the NIDCR mission is fostering the timely transfer of health-related knowledge gained from research to members of the public, health professionals, researchers, and policy-makers — promoting the transformation of health knowledge to health care in ways that meet the needs of individuals and communities. The Institute achieves this goal through its varied interactions with industry and other health-related Federal agencies. The Federal Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programs offer special opportunities to match emerging technologies with NIDCR mission needs.



One case in point is an NIDCR-funded SBIR grant to a small company that brought specialized, point-of-care computed tomography (CT) scanners from laboratory to market in three years with no other financial support. Cone-beam CT has become particularly popular in oral and maxillofacial surgery, endodontics, implant dentistry, and orthodontics, because the images provide three-dimensional information and higher resolution than the two-dimensional data provided by a conventional X-ray image. In addition to installing dental scanners worldwide, the company has also produced a compact CT scanner for high-resolution bone imaging of the sinuses, temporal bones, and skull base and continues to develop new products.

NIDCR will sustain its longstanding relationships with global partners, including international health offices within the U.S. government and non-governmental entities (see “Oral Health Research Across the Globe,” page 33). These ventures align with NIDCR’s research-based mission that advances dental, oral, and craniofacial research for the benefit of health. They enable the Institute to partner with others to improve oral health and oral health research, to enhance diversity efforts in the United States, as well as to contribute to the integration of oral health and general health.



GOAL THREE

3

Apply rigorous, multidisciplinary research approaches to overcome disparities and inequalities in dental, oral, and craniofacial health.

NIDCR-supported research has led to many strategies for promoting oral health and preventing oral disease, but they do not always reach people and communities who need them most. As we discover and adopt newer and better methods to prevent, diagnose, and treat disease, we must improve our ability to translate and disseminate new knowledge effectively for oral health care providers, decision makers, and people in the communities who remain underserved and are at greatest risk for poor health.

Tackling the problem of oral health disparities requires a collaborative, multilevel approach that combines mechanistic, dissemination, and implementation research with community engagement and policymaking. NIDCR's role is to lead the effort to serve communities by funding the best research toward building a strong evidence base for sustainable, acceptable approaches. NIDCR will continue to work with the NIH community, other Federal agencies, professional societies, community organizations, and the public sector, in a determined effort to diminish and ultimately eliminate persistent oral health disparities.

OBJECTIVE 3–1

SUPPORT MULTIDISCIPLINARY, MULTILEVEL RESEARCH AND RESEARCH TRAINING TO OVERCOME ORAL HEALTH DISPARITIES.

NIDCR will continue its substantial investment in oral health disparities research. Current multidisciplinary research teams working to establish the best methods to reduce oral health disparities in their communities are building on discoveries made during the last twenty years of this research program. Beginning with the establishment of regional centers in

the 1990s to the most recent funding of the Centers for Research to Reduce Disparities in Oral Health in 2008, the program was built using a team-science, multilevel approach. The Centers also have expanded the number of researchers from diverse disciplines and backgrounds by providing research training and career development opportunities for young investigators interested in health disparities-related research.

NIDCR will continue its support of research to understand how behavioral, cultural, and social factors contribute to oral health disparities and will apply clinical research strategies to develop effective interventions to prevent and manage oral diseases. NIDCR pursues basic and clinical research on determinants of behavior change, and also emphasizes training and mentoring opportunities for investigators to acquire the knowledge and skills to conduct rigorous research in this area through the use of appropriate behavioral mechanisms, theory, and methods.⁵¹ NIDCR will encourage research that identifies new outcome measures tightly linked to proposed behavioral mechanisms of action — going beyond current proxy measures such as self-reporting. Selected areas of focus include preventing childhood caries, supporting families in establishing lifelong healthy habits, optimizing tobacco cessation strategies for use by dental health care providers, promoting recovery after oral and pharyngeal cancer treatment, managing chronic orofacial pain, and enhancing the oral health of vulnerable individuals, including the elderly.

Given the range of personal, social, economic, and environmental factors that independently and in combination influence oral health, interventions that target these multiple determinants of health are most likely to be effective. NIDCR will encourage research to address disparities and inequalities in oral health through a comprehensive approach including the social determinants of health, health policy, and an understanding of resilience, familial and social context, and social networks and systems within communities. The insight provided by disciplines such as the social sciences, anthropology, economics, political science, health policy and health services, and communications are essential to success.

Oral Health Research Across the Globe

NIDCR supports research in a number of countries throughout the world, and a significant focus area is orofacial clefting — birth defects that occur during early pregnancy when an infant's lip or mouth does not form properly. The result can be cleft lip, cleft palate, or both, and these malformations create problems for feeding, speech, hearing, and dental development. Children with cleft lip and/or palate often endure multiple corrective surgeries, incurring a high emotional and financial toll on their families.

Orofacial clefting is a major public health problem, affecting one in every 500-1,000 births worldwide.^{52,53} International clefting studies yield new understanding about disease causes and progression, and they can lead to new therapies that U.S.-based studies alone might not achieve. For example, research with populations that have a higher birth prevalence of cleft lip/cleft palate enables researchers to identify important relationships between genetic and environmental factors that may be hard to identify in lower risk populations.

Collectively, NIDCR-supported studies related to orofacial clefting include research partnerships or scientists from Singapore, Taiwan, China, South Korea, India, Germany, Denmark, Norway, Finland, Sweden, Hungary, the United Kingdom, the Philippines, Argentina, Brazil, Guatemala, Nigeria, Ethiopia, and Tanzania, as well as within the United States with research participants from specific ethnic groups, such as those of African ancestry, that have been underrepresented in cleft lip/cleft palate research. Multidisciplinary teams participate in this research.

Selected areas currently under investigation include:

- Genetic variants for both diagnostic purposes and understanding disease formation
- Environmental contributors, such as maternal behaviors and other factors
- Other phenotypes that may be related to orofacial clefting (such as defects in lip muscles)
- Epigenetics and metabolism in clefting
- The optimal timing of corrective surgery for cleft palate



Enhanced support for training in dental public health is another strategy for expanding oral health disparities research, and NIDCR will continue to sponsor a 12-month Residency Program in Dental Public Health.⁵⁴ This program also provides experience in other areas of dental public health, such as public health administration and management, and the organization and financing of dental care programs. This initiative is designed to develop the next cadre of oral public health experts steeped in the value of research-based methodologies to fill a growing need for such expertise.



OBJECTIVE 3–2

FOSTER RESEARCH TO PROMOTE THE
TRANSLATION OF SCIENTIFIC KNOWLEDGE
INTO COMMUNITY-BASED ACTION.

Bringing the fruits of research discovery to underserved people and communities is one of the most difficult phases of the biomedical and behavioral research continuum. NIDCR is committed to redressing this persistent problem using a full range of research approaches tested in various communities (see “White House Recognizes Oral Health Researchers,” page 35). NIDCR will

continue supporting communication science and health literacy research that seeks to increase capacity to obtain, process, and understand oral health information and services needed to make beneficial health decisions. Oral health literacy research to date has largely focused on the development of measures and assessment of oral health literacy within populations or settings. Research must now evolve to interventions. The Institute seeks to identify effective structures and programs that may be emulated and/or enhanced and that can be embraced fully by individuals in underserved communities. NIDCR also encourages research that tests methods of health-services delivery through a wide range of potential mechanisms. Dissemination and implementation research are essential to ensure that efficacious approaches do not benefit only the most advantaged in society. NIDCR supports research that seeks to identify, develop, and refine effective and efficient strategies to disseminate and implement evidence-based health promotion,

White House Recognizes Two NIDCR Grantees Advancing Oral Health in Children

The Presidential Early Career Award for Scientists and Engineers, or PECASE, is the highest honor bestowed by the U.S. government on outstanding scientists and engineers beginning their independent careers. In recent years, two NIDCR-funded scientists won this prestigious honor. Both women are investigating issues related to oral health in children.



Margherita R. Fontana, D.D.S., Ph.D., of the University of Michigan School of Dentistry, received a 2011 PECASE award for her research to develop a screening tool for use in primary health care settings to identify underserved young children at higher risk for developing caries. This work focuses on addressing oral health inequities among preschool-aged children. A key motivator for Fontana's research is the troubling increase in dental caries within children aged two to five years, especially in underserved and minority population groups. She views targeted prevention and care as a promising strategy for improved oral health in this age group.

Candidate risk and prevention factors related to caries development in preschool-aged children include transmission of cariogenic bacteria from mother to child, a diet high in sugar and/or starch, oral hygiene practices, and dental care. Also important, Fontana predicts, are those risks stemming from culturally derived eating and behavior patterns. She believes that an objective, easy-to-implement, and validated risk-assessment tool that can be used widely would be extremely useful to identify those at greatest risk so they can be referred for dental care. In particular, she sees the need for such a prevention resource in non-dental settings such as schools, clinics, and physicians' offices. Her caries-risk work is part of a larger prospective longitudinal study that will track the natural history of dental caries in underserved toddlers over a period of three years, in which she will look for other ways to prevent caries in vulnerable populations at the earliest stage possible.

Continues on next page

Continued from p.35



Jessica Y. Lee, D.D.S., M.P.H., Ph.D., of the University of North Carolina at Chapel Hill, received a 2010 PECASE award for defining the role of health literacy in the development of dental caries, particularly in young children. She discovered that very young children that had received services from the Special Supplemental Feeding Program for Women, Infants, & Children (WIC) had significantly less dentally related expenditures than those who had not received this support. Lee concluded that the WIC program has the potential to decrease dentally related costs to Medicaid, while increasing use of dental services.

Lee has also studied how oral diseases in children, if untreated, can lead to serious health problems and significant pain, interference with eating, overuse of emergency rooms, and lost school time. Her research is examining how a low dental literacy population interprets dental health prevention information and navigates the dental health system. Lee's other research foci include health services research, cost effectiveness research, and studies examining access to oral health care and health disparities of young children. One example is a study of pediatric dentists' views on providing nutritional counseling to prevent childhood obesity, and the perceptions of Early Head Start staff regarding their role in providing preventive dental services.



prevention, early detection, diagnostic, and treatment services into public health programs, clinical settings, and to the public.

NIDCR will continue to support community-based participatory research. In this context, the Institute will partner with patient advocates and community organizations to identify factors, both positive and negative, that influence the acceptance of pertinent research-based approaches that promise improved health outcomes community-wide.

An important facet of the NIDCR mission is disseminating knowledge gained through research and its implications for health, to all segments of the American public. This task is particularly relevant for members of underserved populations who have uneven access to understandable information about maintaining health.

The Institute supports an in-house program that serves as a resource for science-based information about dental, oral, and craniofacial health. Its Office of Communications and Health Education will continue to produce and disseminate informational materials in expanded ways to take advantage of various new-media formats on a wide variety of topics. These include children's oral health, oral cancer, periodontal disease, and oral health care for Americans with disabilities. NIDCR also provides materials in print and online to the media, health care professionals, educators and students, patient support organizations, caregivers for individuals with special needs, and the research community.

OBJECTIVE 3–3

PROVIDE SCIENCE-BASED INFORMATION ABOUT ORAL HEALTH AND DISEASE TO HEALTH CARE PROVIDERS, PATIENTS AND CAREGIVERS, POLICY MAKERS, AND THE GENERAL PUBLIC.





GOAL FOUR

4

Ensure that a strong research workforce is dedicated to improving dental, oral, and craniofacial health.

Some of the most remarkable advances in science and technology have come from unanticipated fields of research, where the original discoveries had broader applications than what was originally envisioned. With this in mind, NIDCR seeks to support an ample and diverse pipeline of well-trained and highly competent investigators for years to come. NIDCR believes that a variety of flexible and innovative research training and career development programs is needed to recruit and retain experts with the appropriate skills to conduct oral health research in an increasingly complex environment. The challenges in doing so include i) improving the recruitment and retention of minorities and other underrepresented groups in research, ii) cultivating and sustaining future leaders in clinical and translational research, and iii) developing researchers with interdisciplinary skills to address multipronged issues in oral health. Many of these disciplines are just emerging, yet it is critical that they be woven into ongoing and new research projects.

OBJECTIVE 4–1

COLLABORATE WITH ACADEMIC INSTITUTIONS, ESPECIALLY SCHOOLS OF DENTISTRY, TO CREATE RESEARCH PATHWAYS FOR FACULTY AND TRAINEES.

NIDCR-sponsored individual and institutional research training and career development programs encompass all career stages in the research continuum.⁵⁵ NIDCR's primary focus in this continuum is its strong support of a research emphasis in academic dentistry. NIDCR will continue to offer funding opportunities for established researchers, postdoctoral researchers,

dental students, and undergraduates in various disciplines (See Figure 1, page 41). The Institute will also adapt funding strategies that are flexible in design and duration to attract and mentor qualified individuals to successful careers in oral health research. In keeping with a recommendation from the NIH Advisory Committee to the Director's Working Group on the Biomedical Workforce,⁵⁶ NIDCR will collaborate with academic institutions to evaluate outcomes of NIDCR-supported programs and approaches that support training and make adjustments over time to further enhance the value of these programs.

NIDCR's emphasis on support of individual research training and career development will continue. Such programs have a track record in attracting and retaining oral health researchers. These defined programs include training opportunities for combined dual-degree D.D.S./D.M.D.-Ph.D. students, pre-doctoral Ph.D. students, individuals with dental degrees earning Ph.D. or equivalent research degrees, individuals with a D.D.S./D.M.D.

or other clinical degrees seeking protected time for mentored research training and career development, and individuals with a D.D.S./D.M.D., Ph.D., or other doctoral degree pursuing postdoctoral training. The Institute is committed to supporting and nurturing early-stage investigators as well as those new to oral health research through various means including, but not limited to, the NIH Pathway to Independence Award program⁵⁷ and the NIH Director's Early Independence Award.⁵⁸



In addition to supporting research training and career development for clinical researchers using several individual funding mechanisms, NIDCR encourages oral health scientists and trainees to take advantage of clinical research opportunities within nationwide infrastructures such as the NIH Clinical and Translational Science Award program. The Institute also encourages the oral health research community to develop and maintain clinical research partnerships with the practicing community, and with other sites that support multidisciplinary research teams, including the NIDCR intramural program and the NIH Clinical Center.

Figure 1. Proportion of FY2013 NIDCR Extramural Research and Training and Career Development Support by Type of Academic Institution

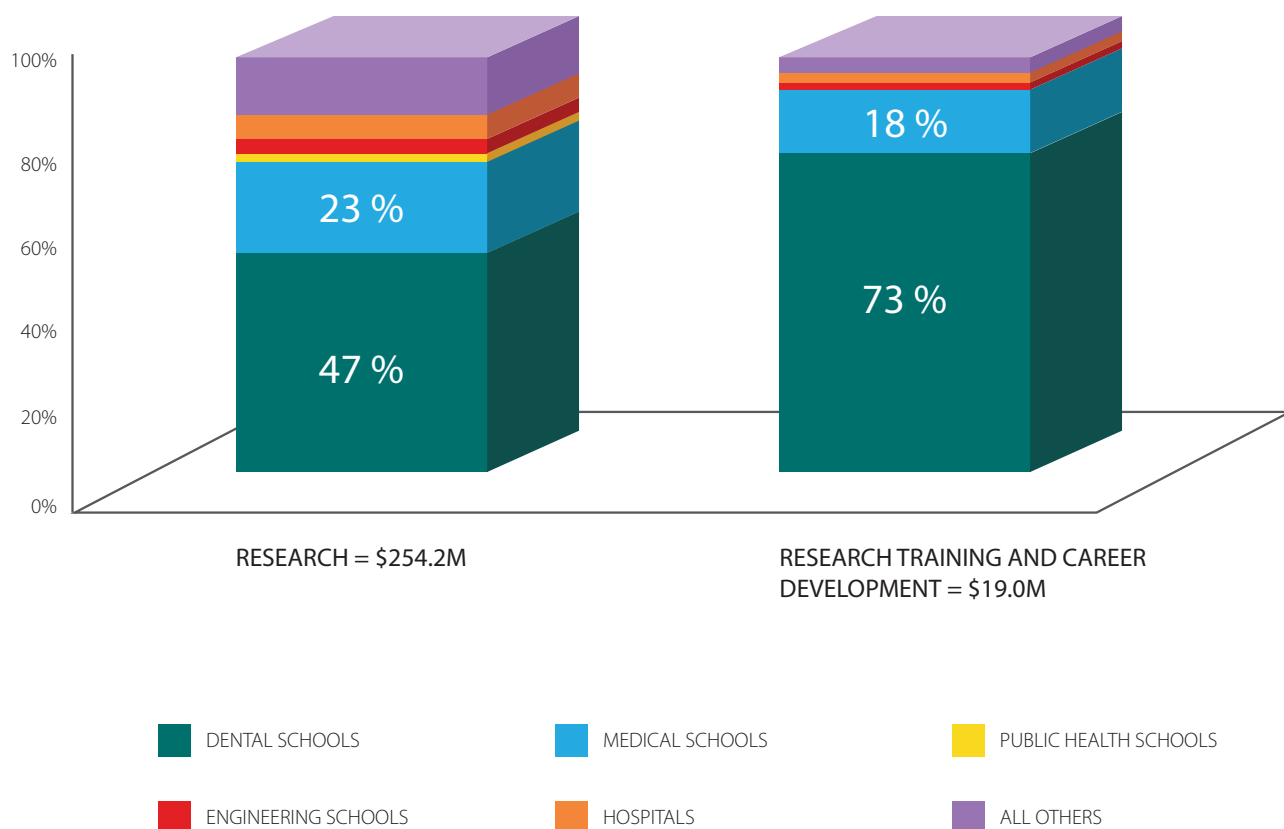


Figure 1 shows the proportion of NIDCR spending for extramural research and research training and career development in fiscal year 2013 by type of academic institution. Dental schools are the largest recipient of NIDCR funding.⁵⁹

OBJECTIVE 4–2

SUSTAIN RESEARCH-RELATED CAREER- ENHANCEMENT OPPORTUNITIES IN RESEARCH.

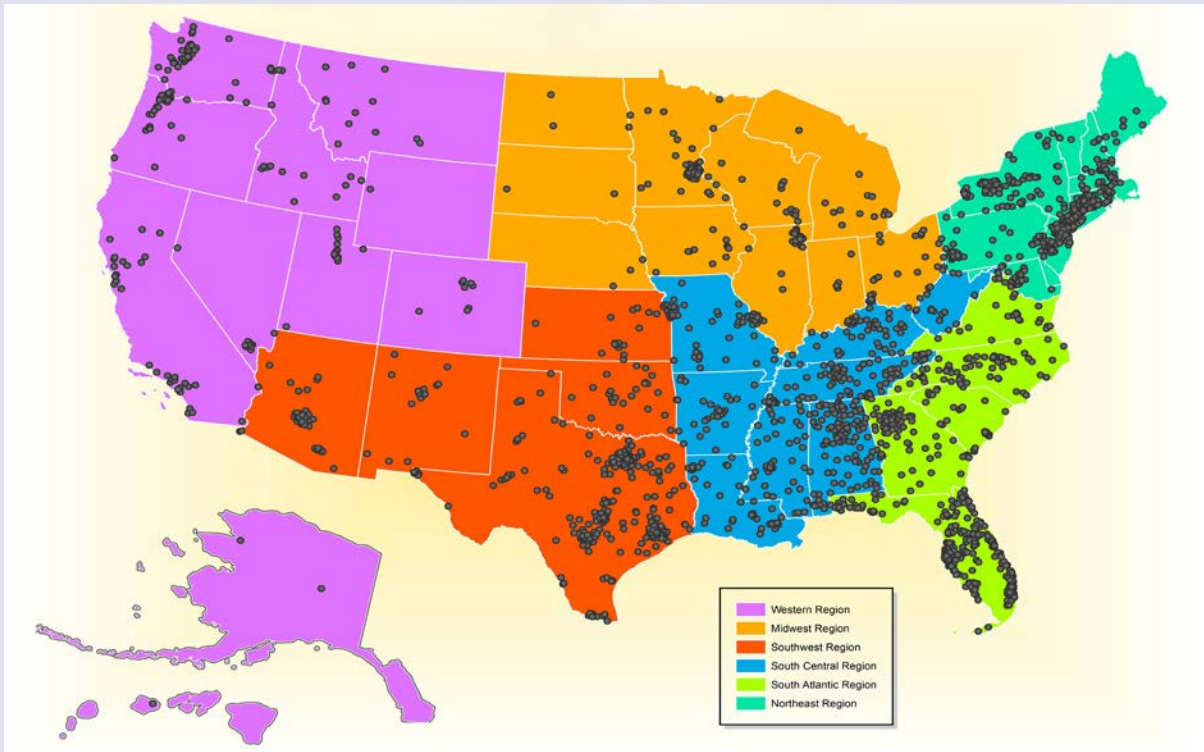
NIDCR will continue supporting dental practice-based research. This program has proven to be a highly effective and innovative method for generating and codifying clinical situations that can challenge and strengthen the oral health evidence base. After launching the Practice-Based Research Network in 2005, NIDCR supported three regional networks across the country.

Each had its own independent affiliated practitioners, clinical studies, and administrative tasks. The second phase of this initiative, launched in 2012, is the National Dental Practice-Based Research Network, or National Dental PBRN, that consists of one national administrative hub that leads and oversees regional research nodes anchored in six U.S. cities.⁶⁰ The expanded network will increase significantly the number of participating practitioners, with the goal of producing data that can be better generalized to the highly diverse U.S. population.

The National Dental PBRN has, in addition, had extraordinary value in growing the oral health workforce to include clinician-scientists conducting research with people in everyday practice settings (see “Postcards from the Field,” page 43). National Dental PBRN studies active or in development include HPV screening, examining potential benefits of devices for detecting dental decay, improving diagnosis and treatment of cracked teeth, identifying factors that predict successful dental crown placements, and testing a dentist-delivered quit-smoking program. An important benefit of the National Dental PBRN initiative has been the increased value of evidence-based practice in the eyes of the practicing community as well as an increased interest and participation in research activities.

NIDCR will consider avenues to encourage bidirectional research, an iterative knowledge exchange between basic scientists and clinicians. Scientific insights into biological mechanisms and disease processes inform and spur new clinical interventions. Conversely, clinical observation about the nature and progression of disease stimulates new basic investigations. NIDCR will consider using new digital tools and technologies to crowdsource research questions and encourage ongoing dialogue on clinical issues, consistent with NIH activities in this arena. Enhanced communication with the practice community will facilitate sharing of research resources, such as biobanks for clinical biospecimens, data-collection tools, and knowledge emanating from new evidence.

The Nation's Network



The National Dental Practice-Based Research Network has about 4,200 enrolled practitioners, representing all 50 states.⁶¹

POSTCARDS FROM THE FIELD

“Instead of reading about the future of dentistry, I was a part of doing the research and building that future. I’ve met colleagues through the PBRN network who have been some of the best and brightest, and they’ve given me ideas and helped to re-energize me in my practice.

“There really is no other way to say it. Joining a PBRN is the best thing that I’ve done for my practice, my patients, and actually myself since graduating from dental school.”

*Dr. Julie Ann Barna, Lewisburg, PA
D.M.D., University of Pennsylvania (1980)*

“The National Dental PBRN has had a positive influence on me and my practice. It has re-energized my enthusiasm by challenging me to improve my critical thinking. Doing these research studies has gently nudged me to stay current, making me a better clinical scientist and in doing so, has opened a new avenue for my professional development.

“By connecting me with other network dentists, this experience makes me feel less isolated from my colleagues.”

*Dr. Paul Benjamin, Miami, FL
D.M.D., University of Florida College of Dentistry (1976)*

OBJECTIVE 4–3

SUPPORT RESEARCH, TRAINING, AND CAREER DEVELOPMENT PROGRAMS THAT VALUE TEAM SCIENCE, TRANSFORMATIVE APPROACHES, AND DIVERSITY AT ALL LEVELS.

NIDCR remains committed to increasing diversity in the biomedical and behavioral research workforce. In 2013, the Institute established a workforce committee to improve efforts to recruit, train, and nurture individuals from diverse backgrounds underrepresented in biomedical research. Investigative activities will include new networking and mentoring opportunities that dovetail with ongoing efforts at NIH to increase

diversity in the biomedical workforce. NIDCR will consider rigorous outreach programs to enlist professional societies, government agencies, academic institutions, industry, and community organizations to develop new approaches to attract and sustain a more diverse workforce confronting research problems in dental, oral, and craniofacial health.

Dental, oral, and craniofacial research investigations often draw from the measures and methods of multiple scientific disciplines. NIDCR will continue to recruit researchers trained in complementary areas of biomedical and behavioral research to oral health research. The NIDCR K18 program, launched in 2013, solicits applications for short-term mentored career enhancement awards in dental, oral, and craniofacial research, with a focus on behavioral and social sciences or genetic/genomic research — two areas of science poised for rapid growth.⁶² This program's intent is to provide



mid-career or senior investigators with short-term training in the theories, tools, methods, or approaches in behavioral and social sciences or genetic/genomic research, or in oral health research, to either i) enrich an investigator's existing dental, oral, and craniofacial research program; or ii) facilitate the introduction of dental, oral, and craniofacial research into an investigator's existing research areas.

The Institute pursues a balanced research portfolio that appropriately embraces the concept of high-risk, high-reward research. NIDCR will continue to participate in NIH Common Fund initiatives that enable such research. These include the NIH Director's New Innovator Award,⁶³ the NIH Director's Pioneer Award,⁶⁴ and the NIH Director's Transformative Research Award.⁶⁵ NIDCR will also participate in the NIH Common Fund Broadening Experiences in Scientific Training (BEST) program,⁶⁶ which aims to enhance biomedical and behavioral research training experiences so graduates are better prepared to enter the modern scientific workforce that extends well beyond academic research.

ABOUT THIS PLAN

In consultation with NIH leadership, NIDCR conducts long- and short-term program planning to identify Institute priorities. These efforts rely on information from several sources and include input from a broad range of key stakeholders including the extramural scientific community, patient advocacy and professional organizations, the National Advisory Dental and Craniofacial Research Council and Board of Scientific Counselors, other NIH Institutes and Centers, other Federal agencies, industry, and ad hoc advisory groups. The Institute also obtains input from participants at conferences and workshops that review emerging scientific opportunities, identify public health concerns, and provide state-of-the-science assessments. NIDCR conducts its planning and priority setting within a larger context that considers input from NIH, the Department of Health and Human Services, Congress and the Administration, and external peer review.

The 2014-2019 NIDCR strategic planning process gathered public and stakeholder input about prospective activities, areas of research emphasis, future research approaches, needs, and opportunities. NIDCR obtained this input in several ways, through:

- A series of individual and group meetings with NIDCR staff to obtain input on NIDCR goals, opportunities, and priorities;
- Presentations and discussions during National Advisory Dental and Craniofacial Research Council meetings;
- A presentation and discussion by the NIDCR Director at the American Association for Dental Research Boston chapter meeting (December 2012);



- A presentation and discussion on “National Oral Health Surveillance: Gaps, Priorities and Future Strategies” at the EpiForum held during the International Association for Dental Research meeting in Seattle, Washington (March 2013);
- A presentation and discussion on “Training the Next Generation of Oral, Dental and Craniofacial Researchers” at the International Association for Dental Research meeting in Seattle, Washington (March 2013);
- An open-forum strategic plan listening session — augmented by informal conversations — at the International Association for Dental Research meeting in Seattle, Washington (March 2013);
- A meeting with leaders of the American Association of Public Health Dentistry, the Association of State and Territorial Dental Directors, and the American Board of Dental Public Health at the National Oral Health Conference in Huntsville, Alabama (April 2013);
- An open-forum conference with NIDCR patient advocate organization representatives (April 2013);
- A day-long NIDCR Bidirectional Research Roundtable Meeting in Bethesda, Maryland (June 2013);
- A day-long NIDCR Oral Health Disparities Roundtable Meeting in Bethesda, Maryland (June 2013);
- 491 online responses from 108 individuals and organizations to six strategic planning questions posted on the NIDCR website between August and September 2013; and
- Public comments obtained through online posting of the draft Strategic Plan (January 2014).

The NIDCR Strategic Planning Steering Committee contributed extensively and provided direction for the development of the plan. NIDCR is indebted to Dr. Alison Davis and Mr. Robert Berendt and to all who provided comments and suggestions through these efforts, which were vital to the development of a workable, dynamic, and responsive 2014-2019 NIDCR Strategic Plan.

NIDCR AT A GLANCE

Part of the National Institutes of Health, NIDCR is the Federal government's lead agency for scientific research on dental, oral, and craniofacial diseases. Scientists supported by NIDCR use modern biomedical and behavioral research tools to conduct research on the full spectrum of topics related to diseases and conditions that fall within the Institute's mission.

In efforts to improve dental, oral, and craniofacial health, NIDCR prioritizes 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 Institute's mission.

Figure 2. NIDCR FY 2013 Funding Distribution by Mechanism

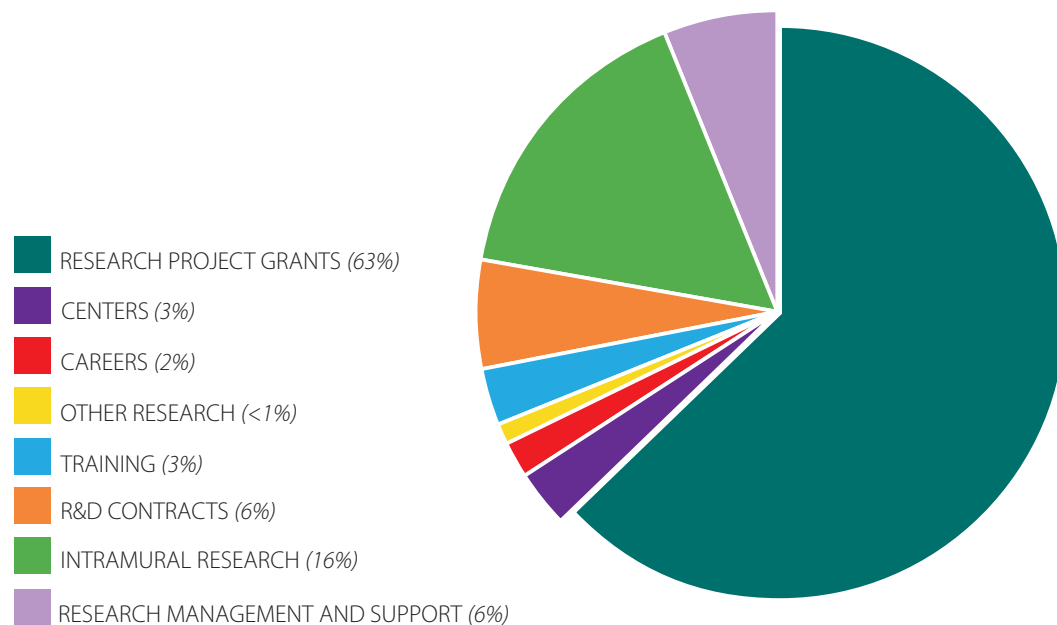


Figure 2 shows the proportion of NIDCR spending across the various funding mechanisms during Fiscal Year 2013 (total of \$387 million), with the majority of the budget used to fund research project grants.

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An embryonic mouse salivary gland undergoing branching morphogenesis with myosin IIA expression (blue) and the basement membrane component collagen IV (red).
- p. 14** Courtesy of Dr. Gary Borisy
The Forsyth Institute
A sample of human dental plaque probed by combinatorial labeling and spectral imaging fluorescent *in situ* hybridization (CLASI-FISH). Shown is *Streptococcus* (pink) adhering to filaments of *Corynebacterium* (green).
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