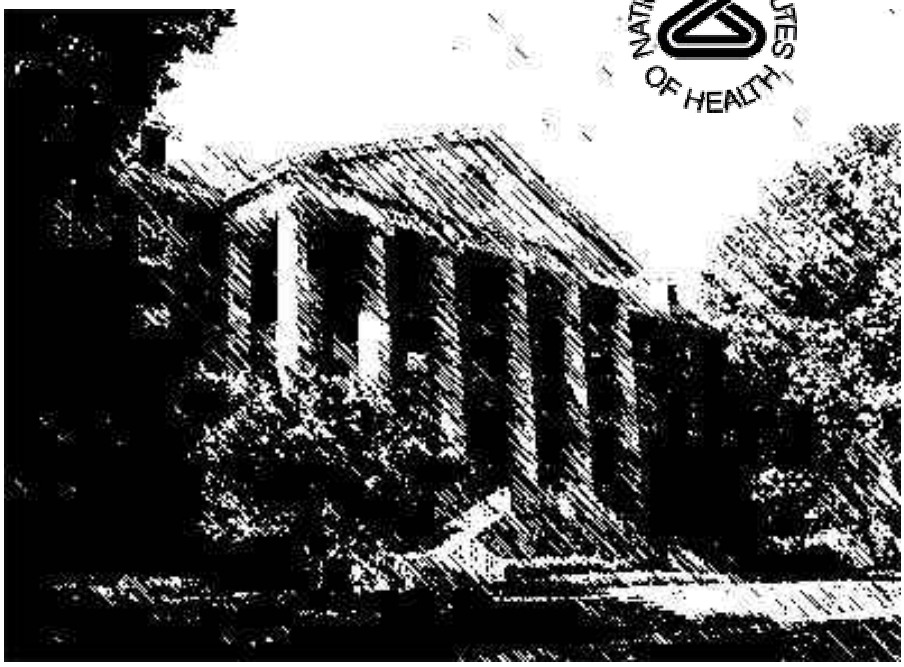
THE NATIONAL INSTITUTES *of* HEALTH

Investments, Progress, and Plans

Selected Examples from FY 1999 – 2003



Genomics
Advanced Technologies
Disease Prevention, Diagnosis, and Treatment
Training and Collaborative Research
Health Disparities
Health Education and Outreach

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Abbreviations

In order of appearance

NHGRI	National Human Genome Research Institute
NLM	National Library of Medicine
NCI	National Cancer Institute
NIA	National Institute on Aging
NIEHS	National Institute of Environmental Health Sciences
NIMH	National Institute of Mental Health
NICHD	National Institute of Child Health and Human Development
NIDDK	National Institute of Diabetes and Digestive and Kidney Diseases
NIDA	National Institute on Drug Abuse
NIAAA	National Institute on Alcohol Abuse and Alcoholism
NCRR	National Center for Research Resources
NIAID	National Institute of Allergy and Infectious Diseases
NIGMS	National Institute of General Medical Sciences
NHLBI	National Heart, Lung, and Blood Institute
NIDCR	National Institute of Dental and Craniofacial Research
NINDS	National Institute of Neurological Disorders and Stroke
NEI	National Eye Institute
NCCAM	National Center for Complementary and Alternative Medicine
NIDCD	National Institute on Deafness and Other Communication Disorders
FIC	John E. Fogarty International Center
NIAMS	National Institute of Arthritis and Musculoskeletal and Skin Diseases
NCMHD	National Center on Minority Health and Health Disparities

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In Fiscal Year 1999, the support of the American public, the Congress, and the Administration produced a commitment to double the funding for NIH by 2003. The NIH Institutes and Centers have strategically invested the increases provided since 1999 to take advantage of the enormous scientific opportunities to improve health and understand diseases. Although scientific accomplishments often take many years to unfold into new diagnostic tests and new ways to treat and prevent diseases, the confluence of this generous appropriation with extraordinary scientific opportunity has already begun to yield amazing results.

The draft of the DNA sequence of the human genome is the best known of the new tools helping scientists understand how the human body works and what causes disease. But there are several new lines of research that are changing the way biomedical research is done. These include proteomics–the analysis of large sets of proteins (the products of genes) with the goal of understanding their function; combinatorial chemistry–a new way to generate large libraries of molecules that can be screened for use as drugs; and new, advanced imaging techniques that enable scientists to see within the body as it carries out various functions. Molecular biology techniques, computer power, and robotics are enabling scientists to move from studying one gene or one protein at a time to studying entire sets of genes and proteins, and figuring out how they interact. As a result, progress in the biomedical sciences is moving at a speed that could only be dreamed of just five years ago.

All these new opportunities require a shift in how medical research is funded and conducted. The principal investigators supported by NIH will continue to be the bedrock of medical science. However, the teams that those scientists lead have become much larger and more complex because of the need for specialists in areas other than biology including imaging, chemistry, computer science, mathematics, and informatics, which uses computer and statistical techniques to manage extensive amounts of data. Projects comparing the human genome to the genomes of nonhuman primates and other organisms such as the rat, fruit fly, and yeast will require much larger teams to achieve success. Moving discoveries in basic research into clinical trials now requires setting up teams to design protocols, recruit participants, conduct the trials, and analyze the data. This shift in how NIH approaches funding medical research today is reflected in this document.

The following sections describe some of the scientific progress that has followed from the NIH's investment of the additional funds. They are grouped into broad areas that NIH sees as having the greatest potential to provide innovative strategies for the diagnosis, treatment, and prevention of diseases and greater understanding of human health. The selected highlights of research advances in each area would not have been possible without increased funding from Congress, nor will new initiatives and further progress happen without continued increases.

GENOMICS

Now that a draft of the human genome sequence has been completed, much more work lies ahead–figuring out what all those genes do, when they are selectively turned on or off, and how all these genes interact with each other to make and maintain a person. Genomics techniques, driven by the sequencing of the human genome, robotics, and computer technology, are quickly helping us to better understand how a human develops and how things go wrong in the body to cause disease.

Human Genome Project: In February 2001 the International Human Genome Consortium published the complete description of the draft of the DNA sequence of the human genome simultaneously with the private company, Celera Genomics. This is one of the most important milestones on the never-ending quest to better understand ourselves and the wonder of life. Because of the increased funding provided to the National Human Genome Research Institute (NHGRI), the sequence was achieved much faster than previously predicted. More than 30 genes for human diseases, including various types of cancer, deafness, and birth defects, have already been identified. Scientists are now using the information to go to the next step of developing better diagnostics and therapeutics. Researchers should have a high quality, final sequence with no gaps by 2003.

Human Sequence Databases: Substantial increases in the NIH budget have made it possible for the National Library of Medicine's (NLM's) National Center for Biotechnology Information (NCBI) to keep pace with the enormous amount of data coming out of genome research laboratories around the world and to provide the DNA sequence in an organized resource on the Web that is freely accessible to all, with no restrictions on its use or redistribution. NCBI now supports and distributes more than 30 databases and research tools for the medical and scientific

communities. The information is searched daily by scientists in academia and industry.

Human Genetic Variation: The DNA sequence of any two people is 99.9 percent identical. The 0.1 percent difference includes genetic variations that apparently have no effect at all, as well as variations that are associated with differences in the risk of getting various diseases or having an adverse drug reaction. Now that nearly three million of these variants have been discovered and the information is stored in public databases, researchers working on the genetics of heart disease, diabetes, cancer, mental illness, and a host of other medical problems can move forward in their search for ways to diagnose, treat, and prevent these diseases much more swiftly than previously possible. The additional funds have moved this research along very rapidly and NHGRI's goals for 2003 have already been achieved.

Cancer Diagnosis: Over the coming years, physicians will be able to make precise molecular diagnoses of cancer and thus treat patients more effectively than ever before thanks to powerful new technologies like DNA microarrays. With a microarray chip–similar to a computer chip–scientists can look at how thousands of genes are expressed at once, a scale previously unimaginable. Using this technology to look at approximately 1.8 million measurements of gene expression from 96 different samples, scientists and grantees of the National Cancer Institute (NCI) and others discovered that there are actually two subtypes of diffuse large B-cell lymphoma (DLBCL), the most common form of non-Hodgkin's lymphoma. They solved the mystery of why 60 percent of DLBCL patients don't respond well to standard chemotherapy and die, i.e., they have a biologically different type of the disease than patients who do respond to the therapy. This is just the first demonstration of a technique that promises to revolutionize cancer diagnosis and treatment as well as many other areas of scientific research.

Genes and Aging: In an initiative of the National Institute on Aging (NIA), scientists are using microarray technology to profile changes in gene activity associated with aging. More than 100 facilities worldwide have received a set of 15,000 candidate genes and researchers have started to prepare microarrays; the set is now being expanded to 30,000 genes. Other NIA-funded investigators have already identified genes that seem to affect aging in several lower organisms. NIA is also supporting epidemiological studies to increase understanding of how genetic factors influence a healthy longevity.

Genes and Environment: Scientists are now realizing that defining the complex interactions between genes and the environment will be necessary to understand the root causes of most major diseases. The Environmental Genome Project (EGP) was initiated by the National Institute of Environmental Health Sciences (NIEHS) to identify critical variations in the genes that affect an individual's response to toxins or other substances in the environment that could be involved in environmentally-associated diseases such as cancer, birth defects, asthma, and, based on new evidence, Parkinson's Disease.

Gene Hunting for Schizophrenia and Manic-Depressive Illness: Advances in understanding the genetic bases of mental disorders are expected now that the complete description of the draft human genome sequence is available along with new tools and technologies. The National Institute of Mental Health (NIMH) is supporting new approaches to map genes that produce vulnerability to schizophrenia, manic-depressive illness, and related conditions. The Institute will also fund projects to identify, in schizophrenic and manic-depressive patients, those genes that influence the response to therapeutic drugs.

Birth Defects and Inherited and Developmental Disorders: The National Institute of Child Health and Human Development (NICHD) has launched an effort to develop new ways to diagnose and prevent a range of birth defects and inherited and developmental disorders, including Fragile X Syndrome, the most common form of inherited mental retardation in the United States; Rett Syndrome, a crippling brain disorder that strikes baby girls; and autism. NICHD is leading the trans-NIH efforts to expand research on birth defects using animal models that have easy-to-visualize embryos such as the zebrafish and the frog.

Genes for Diabetes: The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) and NHGRI have taken steps to find genes involved in diabetes and its complications. Recently scientists identified a gene for non-insulin-dependent diabetes (also known as type 2), a potential new target for treatment or prevention strategies. NIDDK is also planning the Diabetes Genome Anatomy Project, which will profile genes in all tissues relevant to diabetes, including fat, muscle, and kidney, to gain insight into the origin and development of diabetes and its complications.

Genetics of Addiction: In 1999, the National Institute on Drug Abuse (NIDA) launched an initiative to understand the roles of genetic and environmental factors in susceptibility to becoming addicted. NIDA now has more than 60 major projects

using genetic analysis techniques to identify genetic factors that are critical in addiction. The National Institute on Alcohol Abuse and Alcoholism (NIAAA) is also using microarray technology to identify genes in the brain that play a role in disorders involving alcohol use and abuse.

Mouse Genome: Much of the progress in understanding and treating human diseases has come from research using experimental animals, especially the mouse. Because mice and humans share virtually the same set of genes, the sequence of the mouse genome will provide a critical perspective to help researchers understand the human genome. Scientists will be able not only to find genes easily in the sequence of the mouse genome, but they can also test possible therapeutic agents in mouse models of human diseases. The effort to sequence the genome of the laboratory mouse was launched by NIH under NHGRI leadership in October 1999. In October 2000 the mouse genome sequencing effort was accelerated by the creation of the Mouse Sequencing Consortium (MSC), comprising six NIH Institutes, three private companies, and the Wellcome Trust–the world's largest medical research charity. Without the additional funds that Congress provided to NIH, mouse sequencing would have started much later and the current goal of finishing the mouse sequence by 2005 would not be possible.

Mouse Mutants: The National Center for Research Resources (NCRR) has developed regional facilities to provide mutant mouse resources to the medical research community. Scientists can now create mice with specific mutations in their DNA that can be valuable in research on a wide range of afflictions including cancer, diabetes, neurological and cardiovascular diseases. NCRR's centers maintain and characterize genetically modified animals and their embryos or gametes submitted by the scientists who create them. This program ensures that other researchers can then obtain high-quality mice with the exact mutation they want to investigate. Four centers and an Informatics Coordinating Center have been established. Parallel efforts with rats would be undertaken with additional funding.

Genomes of Bacteria, Viruses, and Parasites: The National Institute of Allergy and Infectious Diseases (NIAID) is taking steps to capitalize on the recently deciphered gene sequences of organisms such as the bacteria that cause tuberculosis, gonorrhea, strep throat, and severe diarrhea and death from contaminated food. The Institute has issued a request for proposals to establish a center that would provide researchers with a wide range of resources and technologies to study the function of the genes of such organisms. The potential insights could revolutionize research on

infectious diseases and could lead to the development of new vaccines, therapies, and diagnostics for them.

ADVANCED TECHNOLOGIES

Genes are just one of the components that make the body work. Genes tell the cell what sorts of proteins to make. Proteins are the worker molecules that assemble and maintain the mind-boggling complexity of our bodies. New approaches to studying protein structure and function will bring great insights into the study of diseases and the design of new drugs. Other exciting fields of research described in this section include the development of chemical libraries for discovering new drugs and advanced imaging techniques.

Structural Genomics: Knowing the shapes of proteins is the key that opens the way for scientists to better understand how proteins function normally and how faulty protein structures can cause disease. The National Institute of General Medical Sciences (NIGMS) has organized a large-scale effort in structural genomics, which involves the use of complex techniques to predict the three-dimensional shapes of proteins from gene sequences. In September 2000, NIGMS provided the first year of funding for seven pilot research centers, each of which will be funded for five years. The goal is to develop a public database of protein structures. In 10 years, NIGMS hopes to have 10,000 structures in a database that will be freely available to the scientific community.

Response to Medicines: Pharmacogenetics is the science of how a person's genes influence how he or she responds to medicines, including antidepressants, chemotherapy, and asthma drugs. NIGMS is leading a trans-NIH effort in which a network of investigators will store data in an electronic library that is freely accessible to the scientific community. The first nine awards for the pharmacogenetics network were made in April 2000. The long-term goal of this research is to help doctors tailor doses of medicine to a person’s unique genetic make-up. This will make medicines safer and more effective for each individual.

Toxic Chemicals: Estimates are that 70-75 percent of high-volume, high-use chemicals (about 15,000) in commercial use in the United States have not been assessed for whether or not they can cause cancer or have some other toxic effects in humans. Current toxicity tests are too costly and take too long to perform to relieve this information shortfall. To address this need, NIEHS is spearheading a national

effort that merges toxicology with genomics–creating a new field of toxicogenomics–to identify which chemicals are toxic or carcinogenic using the new microarray technology. NIEHS is establishing five regional centers whose work will lead to toxicity test systems that can be cheaper, faster, and more informative than those currently in use.

New Organs and Tissues: In the United States, the total cost of health care for patients who have lost organs or tissues–such as the air sacs in the lung, a heart valve, or blood vessel–due to damage or disease exceed $400 billion annually. Because of the dearth of transplantable organs, many of these people die. In an effort to improve the treatment of heart, lung, and blood diseases, the National Heart, Lung, and Blood Institute (NHLBI) will award grants to develop ways to "grow" functional tissues and organs to replace those that are lost or damaged, and create suitable substitutes such as artificial blood components or heart valves.

Repair and Replacement of Tissues of the Face and Head: With Americans living longer, there is an increased need to repair and restore damaged bone and tissue. The National Institute of Dental and Craniofacial Research (NIDCR) is using the new discipline of biomimetics–a combination of cellular biology, molecular biology, materials sciences, engineering, dentistry, and medicine–to develop novel approaches to repairing and replacing oral and facial bones and tissues. These would include fully functional muscle tissues that could be used in reconstructive surgery of the face and head. Other projects under way are focusing on the reconstruction of hard tissues like the temporomandibular joint, which connects the lower jaw to the side of the head.

Drugs for Neurological Disorders: A better understanding of the molecular bases of neurological disorders provides scientists with new targets for developing drugs to treat these problems. However, industry is not focusing on most of these disorders. Therefore, the National Institute of Neurological Disorders and Stroke (NINDS) is developing programs to remove the technological barriers to drug development and encourage academic investigators to address this need. For example, NINDS is providing them with access to advanced technology for screening drugs, support for the development of rapid tests of potential new drugs, and logistical and financial help to screen compounds already approved by the FDA for other uses.

Drug Addiction: New technologies that are not invasive–such as MRI–that allow researchers to not only "see" inside the brain but also to "see" how it functions are

enabling them to ask questions that were not possible just five years ago. A new program of NIDA will study children whose mothers were drug addicts when they were pregnant in order to determine the effects of prenatal drug exposure on brain development. The scientists want to determine whether these children are more vulnerable to cognitive deficits and to drug abuse as they become adults than those whose mothers did not use drugs while pregnant. Researchers are also using the new technologies to "look" into the developing brains of children and adolescents in order to study the long-term effects of drugs such as MDMA (ecstasy) and methamphetamine. In addition, emerging technologies are helping investigators predict who may be most likely to become a drug user. Scientists have already discovered that the number of certain dopamine receptors in a person's brain may predict whether or not he or she will find use of a drug pleasant. Sophisticated techniques are also enabling researchers to "see" how drugs of abuse compromise an adult's cognitive and behavioral abilities.

Understanding Alcohol Addiction: NIAAA is supporting research to identify the circuits of brain cells involved in biological adaptations to alcohol use such as craving, withdrawal, recovery, and relapse. Imaging techniques that are not invasive will be used to track alcohol's effects in the brain. Identification of the genes involved in disorders of alcohol use will provide vital information for developing new medications.

Chemical Libraries: NIGMS is planning to fund centers to encourage chemists to develop new methods to create collections of immense numbers of different molecules made from a few building blocks of chemicals; these are known as combinatorial chemistry libraries. Scientists are already using these libraries to rapidly screen thousands of molecules in order to discover potential new drugs, but their use is limited by current methods. NIGMS wants to encourage chemists, biologists, and engineers to work together to enhance the quality and diversity of these libraries so they can be used to study biological processes.

Assistive Devices for the Visually Impaired: The National Eye Institute (NEI) has established multidisciplinary research teams to develop new technologies to help both doctors and the four million Americans who have low vision or are legally blind and the 200,000 who are totally blind. Scientists and engineers are working to develop assistive devices to help these people, as well as to design environmental modifications that would make street intersections safer for pedestrians who are blind or visually impaired. Other projects include the development of instruments that would greatly improve the examination of eye

tissues by doctors and researchers. Scientists are also working to develop a device that can be implanted to stimulate the retina of patients blinded by degeneration of the retina. (The retina is the part of the eye where light is captured by special cells and the electrical signals–which the brain uses to process visual information–are initiated.).

DISEASE PREVENTION, DIAGNOSIS, AND TREATMENT

Clinical research is the crucial step for translating basic science into better health for everyone. This new age of medical research–with advanced molecular and imaging techniques–is providing unprecedented opportunities to design new ways to prevent, diagnose, and treat many diseases and conditions.

Early Cancer Detection: NCI has established a network for collaborative research on biomarkers. Biomarkers are internal changes in molecules or cells in the body that would signal the development of a precancerous cell or the change of a precancerous cell to a cancerous one. By identifying and measuring these changes in cells or body fluids, physicians would be able to detect cancer and assess cancer risk earlier. Within a year of initial funding, researchers published their findings on 18 promising biomarkers. Three markers associated with a variety of cancers including bladder, head and neck, and lung, have advanced to the validation stage. Also, a group of scientists has developed a novel approach to the early detection of cancer based on identifying gene mutations in the DNA housed in the cell's many mitochondria–structures inside a cell but outside its nucleus that produce energy–rather than in just the cell's single nucleus. This should make mutations connected with cancer much easier to find and lead to non-invasive methods to screen people for cancer using easily collected body fluids like blood or urine.

Alternative Cancer Therapies: The National Center for Complementary and Alternative Medicine (NCCAM) aims to expand options for safe and effective cancer therapies. The Center has awarded grants to study treatments for breast cancer and to conduct the first controlled trial of PC-SPES, a Chinese herbal mixture, in two diverse groups with high rates of prostate cancer (African Americans and Chinese who live in Singapore). Other scientists are studying hyperbaric oxygen (oxygen at greater-than-atmospheric pressures) for the treatment of head and neck cancers.

Treating Diabetes: NIDDK is supporting studies on the transplantation of human islets into patients. These islets, located in the pancreas, contain the beta cells that produce insulin, the hormone that helps the body use sugar for energy. The Institute has also set up a consortium to facilitate efforts at regenerating beta cells, develop new sources of islet cells from adult stem cells, and understand the basis for the failure of islet cells in type 2 diabetes. Research sponsored by NIDDK has already identified certain genes crucial for the development of islets and beta cells.

Blocking the Effects of Alzheimer's Disease (AD): The National Institute on Aging (NIA) is accelerating research to delay or slow the progress of AD or to prevent the disease entirely. Already scientists have identified new targets to directly block the disease's effects in the brain and are developing imaging and other tests to diagnose people in early stages of the disease. Major prevention trials are under way on vitamin E and on the drug Aricept, as well as on anti-inflammatory drugs and estrogen. NIA also is funding a five-year initiative to speed the development of a vaccine and other novel approaches for preventing AD.

Preventing and Treating Parkinson's Disease (PD): A recent study showed that environmental factors accounted for the majority of cases of PD that developed in people after age 50. Based on these findings, NIEHS is funding 25 grants to investigate the role of environmental agents such as pesticides, solvents, and metals as risk factors for PD. The Institute is also supporting research to develop animal models of the disease. Findings from these studies should lead to new insights for preventing or treating the disease. NINDS is also developing a program of clinical trials focusing on drugs that, unlike current options, actually slow the course of PD.

Autism Centers of Excellence: NIMH will be the lead institute at NIH for establishing a network of centers–as specified in the Children's Health Act of 2000–that will adopt integrative approaches to study ways to prevent, diagnose, and treat autism. NINDS, NICHD, NIDCD, and possibly others will support this network. These centers will conduct research into both basic and clinical aspects of autism including its cause, early detection, diagnostic problems, treatment, and prevention.

Treating Mental Illness in Children: NIMH will expand its research network to include up to nine new units and a coordinating center to study the medications and psychosocial interventions that are being used to treat mental disorders in children and adolescents. Scientists at these units will focus on the safety of the medications, especially those drugs approved by the FDA for adults

and older children that are being given to younger children even though the drugs have not been adequately tested in their age groups. Special emphasis will be given to treatments for children with autism and other pervasive developmental disorders.

Ear Infections in Children: Middle ear infection (otitis media) is one of the most significant health problems for children in the United States, costing about $4 billion to $5 billion annually. The effectiveness of the antibiotics used to treat this disease is being hampered by the emergence of drug-resistant organisms so scientists are focusing on ways to prevent the disease in the first place. Scientists from The National Institute on Deafness and Other Communication Disorders (NIDCD) have developed a vaccine against the organism that is the leading cause of childhood ear infections for which there currently is no vaccine. A Phase I safety trial is nearing completion in adult volunteers; preliminary data indicate that the vaccine may be useful for preventing otitis media in children.

Heart, Lung, and Blood Diseases: Many doctors do not incorporate evidence-based guidelines into their treatment plans for their patients. This lack of communication between the clinical researchers and the practicing physicians may cause patients to suffer needless illness and death. As an example, providing state-of-the-art treatment to all patients experiencing heart attacks could help prevent an estimated 18,000 deaths per year. NHLBI will support research to determine why physicians do not apply research results in their practices, even when research results are incorporated into clinical recommendations and guidelines designed to help them treat their patients.

Acute Stroke Centers: NINDS will support a network of acute stroke centers across the United States, each capable of treating patients rapidly and serving as a clinical laboratory for scientific studies related to acute stroke, including tests of new drugs. The first effective treatment for acute ischemic stroke, the drug TPA, is only partly effective and cannot be used in all types of strokes. NINDS has demonstrated the potential of other drugs for stroke in laboratory studies but has been hampered in translating those findings into practical treatments by the slow emergence of state-of-the-art centers for acute stroke.

AIDS Prevention and Treatment: The Dale and Betty Bumpers Vaccine Research Center (VRC) on the NIH campus is focusing initially on the development of a vaccine against AIDS. The VRC's world-class team of scientists—supported by NIAID and NCI—are in the process of generating several candidate vaccines. In July 2000, NIAID expanded its networks for HIV vaccine and other prevention

research so that clinical trials can be conducted in this country as well as in other countries devastated by the AIDS pandemic. In FY 2001, funds will be awarded to prepare for clinical studies, including the first Phase III trial funded by the Federal government on the effectiveness of an HIV vaccine candidate, and safety and efficacy trials of several topical microbicides and of methods to block transmission of HIV from mother to child during the birthing process. NIAID hopes to launch a program to provide long-term support for studies to develop practical, affordable, and acceptable methods to prevent and treat HIV/AIDS in developing countries.

HIV Transmission to Infants: The Fogarty International Center (FIC) is leading a partnership with nine NIH institutes that supports research training critical to preventing AIDS both in the United States and abroad. In an FIC-supported study, researchers in Nairobi collaborated with scientists in the United States to evaluate the rates of HIV transmission to infants through breastfeeding. They found that 44 percent of the HIV infections in infants born to HIV-infected mothers in the group that breast-fed were due to breast milk. This study clearly shows the need to prevent transmission of HIV through breast milk and has major implications for public health interventions in developing countries. Additional studies are under way to address the complex social and economic implications of infant feeding.

Center of Musculoskeletal Medicine: The National Institute of Arthritis and Musculoskeletal and Skin Diseases, along with NIDCR, NICHD, and NIA, are focusing resources to form a new National Center of Musculoskeletal Medicine. This state-of-the-art center will bring together scientists from a wide variety of specialties to conduct basic and clinical research on bones, joints, and muscles. The diseases that would be studied include arthritis, osteoporosis, low back pain, temporomandibular joint disorder, and genetic diseases of the cartilage and bone. The NIH Center will also serve as a national resource in this critical and under-served area of research.

Overcoming Salivary Gland Problems: NIDCR is using tissue engineering to develop an artificial salivary gland. An estimated one million people lose the function of their salivary glands due to an autoimmune disease known as Sjögren's syndrome or radiation therapy for head or neck cancer. These people may have trouble speaking, chewing, and swallowing, along with other problems such as infections, loss of taste, and considerable discomfort. No effective treatment currently exists to help these patients. NIDCR scientists are designing an artificial salivary gland that could be ready for clinical testing within 5-7 years.

Drug Abuse Treatment: NIDA has established a national network to test drug addiction treatments–that are based on scientific studies–in communities rather than in specialized research settings. The network consists of researchers who have formed partnerships with the health professionals–such as doctors, nurses, psychologists, and counselors–in communities who are actually treating drug addicts. Since September 1999, this network has grown to include 14 research centers across the country working in partnership with more than 80 treatment providers who use varied approaches and serve diverse patient populations. Patients are already participating in the first seven protocols. In FY 2002 NIDA plans to add sites in areas now unrepresented and to add approximately 160 treatment providers such as community clinics.

Nicotine Addiction: NIDA will significantly expand its nicotine research portfolio to focus on the development of more effective treatments to combat addiction to nicotine. NIDA will continue to develop interventions that are tailored to stop adolescents from smoking and will work with NCI to expedite the development of medications to help people stop smoking.

TRAINING AND COLLABORATIVE RESEARCH

Today's research challenges require training and expertise in many disciplines beyond biology and medicine. Scientists from different fields now cooperate routinely: chemists designing molecular probes with cell biologists, psychologists working with neuroscientists to understand the workings of the brain, and experts in genomics working with those who develop drugs. New initiatives either cross-train medical researchers in other scientific areas or help them collaborate with mathematicians, computer programmers, engineers and other types of scientists.

Computer Analysis of Biological Data: Medical research is entering an era in which the use of computers to analyze huge volumes of biological data is essential. NIGMS has funded centers that will conduct research and provide academic institutions with the means to recruit and train a cadre of scientists who can conduct interdisciplinary research in complex biological systems and bioinformatics–the development of methods to analyze huge amounts of biological data such as that generated by the Human Genome Project. NLM also supports several programs at universities to train experts to carry out research in general informatics and bioinformatics.

Virtual Cell: NIGMS created an initiative to "glue" together large groups of scientists pursuing some of the biggest unsolved problems in medical research today. In September 2000, NIGMS made the first "glue" grant to a consortium of basic scientists that is studying communication within and between different cells. The consortium has already compiled a list of more than 2,400 proteins involved in cellular communication. By eventually creating a "virtual cell," scientists will be able to design "wiring diagrams" for healthy cells. This should greatly enhance the process of developing drugs for treating a wide spectrum of diseases including heart disease.

Women's Health: A trans-NIH initiative has appointed nearly 60 scholars in the 20 new Women's Health Research Career Development Centers. These centers have been established around the country to enable newly trained obstetricians/gynecologists to enter research careers addressing such concerns as endometriosis, fibroids, and hormone regulation. Other initiatives ensure that these physicians obtain rigorous training in epidemiology and methods involved in conducting clinical trials.

Sex and Gender Differences in the Immune System: NIAID, NINDS, NIAMS, and others are requesting grant applications for multidisciplinary research to identify and characterize sex and gender-based differences in the immune system that may play a role in autoimmune diseases such as multiple sclerosis and rheumatoid arthritis, as well as infectious diseases and allergies. Knowledge of differences in the immune response should lead to the development of treatments or prevention strategies specifically designed for men or for women.

Alcohol and the Brain: Additional funding is enabling NIAAA to integrate research from different fields such as genetics, molecular biology, and behavioral science that contribute to our knowledge of how alcohol acts on the brain. Identification of the network of nerve cells and thousands of molecular and genetic events that underlie the biological process by which a person becomes dependent on alcohol will provide new biological targets for scientists to develop drugs or strategies for treating those who abuse alcohol or are alcoholics. NIAAA has also established three new laboratories on the NIH campus to encourage a multidisciplinary approach to alcoholism and alcohol-related diseases.

Putting the Pieces Together: NIGMS has created a set of initiatives to promote quantitative, interdisciplinary approaches to solving medical research

problems, essentially putting together all the “little” pieces of information we have from various areas of research to get the “big picture” of how the body does things. These approaches are necessary to begin to understand the complex, interactive behavior of the many systems in the body, such as how cells communicate and how organs "talk" to each other. The long-term goals of such studies include understanding all of the genetic and environmental factors that work together to regulate processes such as the development of embryos or of complex disorders like heart disease. A key part of this effort is recruiting mathematicians, physicists, engineers, and computer scientists to work on these medical problems.

HEALTH DISPARITIES

NIH is committed to helping eliminate health disparities that affect minority populations and the medically underserved by increasing research into these areas, providing research opportunities to scientists from minority populations, and enhancing outreach efforts. Each NIH component is exploring ways to eliminate or reduce disparities in disease areas. NIH health disparities research is now being coordinated through the National Center on Minority Health and Health Disparities (NCMHD), established in December 2000.

Cancer Centers for Population Health: NCI will create four Centers for Population Health beginning in 2002 to expand the understanding of social and environmental causes of gaps between minorities and the rest of the population in the diagnosis and treatment of cancer. The centers will develop evidence-based interventions to improve the health of such populations.

Reducing Preterm Births: Prematurity and low birth weight are the leading causes of death among African American infants at a rate five times that of white newborns. Research suggests that one-third of premature births could be due to infections or inflammatory diseases in the mother. To further investigate this link, NICHD will supplement existing clinical trials and fund new ones to assess the most effective strategies to treat and prevent infectious and inflammatory diseases in pregnant women at greatest risk of preterm birth.

Reducing Sudden Infant Death Syndrome (SIDS): While public outreach initiatives to place infants on their backs to sleep have helped to reduce overall SIDS rates, disparities in these rates persist among some minorities. NICHD will expand its outreach to Native American communities, where the highest SIDS rates in the United States exist. Preliminary data showing a strong association between

alcohol exposure and SIDS has spurred NICHD to collaborate with NIAAA and at-risk communities to examine how exposure to alcohol before birth affects the developing fetus. The goal is to develop specific therapies and prevention strategies that are culturally appropriate to protect the mother and her developing child.

Geographic and Racial Differences in Stroke: The well-documented disparities between the people living in the "stroke belt"–ten southeastern states and Indiana–and other areas of the United States cannot be explained by known risk factors and racial characteristics. NINDS will fund a large-scale study—using an innovative combination of home visits and clinical measurements—to investigate questions about stroke disparities that have puzzled scientists, clinicians, and policy makers for years.

Hepatitis C in Minority Populations: A large proportion of people, especially African Americans, do not respond to new treatments–such as interferon and ribavirin–for hepatitis C, a major cause of chronic liver disease and liver failure. To understand and combat this, NIDDK has launched several major clinical trials, spearheaded an NIH-wide request for grant applications for the study of the treatment and prevention of hepatitis C, and developed plans for a health awareness campaign for minority populations.

Programs to Train Minority Scientists: NIGMS administers research and research training programs aimed at increasing the number of minority biomedical scientists in the United States. In the past three years, NIGMS funding for all of its minority programs has nearly doubled, predominantly due to funding more research and implementing new programs for minority students. The number of minority students participating in the Institute's Minority Biomedical Research Support Program has nearly doubled–from 1000 to 2000–during the period from 1997 to 2000. In addition, NIH has established a new training program, known as The NIH Academy, that will create a diverse cadre of medical scientists who are interested in conducting research to eliminate health disparities in the United States. These scholars will receive research training in laboratories on the NIH campus, as well as attend workshops and other educational activities about research on health disparities.

Clinical Research Training at Institutions That Serve Minorities: NIAMS, in partnership with NIDDK, NCMHD, and nine other NIH components, created a new strategy for enhancing clinical research training in institutions that serve minorities in order to produce well-trained clinical researchers who can lead

clinical research projects. The first phase, to be funded in FY 2001, is a solicitation for a one-year planning grant, and the second phase will be a five-year grant to assist in the actual development of the clinical research curriculum.

Specialized Neuroscience Research Programs (SNRPs) at Minority Institutions: Since FY 1999, NINDS, working with NCRR, the NIH Office of Research on Minority Health (the predecessor to NCMHD), and other Institutes, has expanded its original SNRP center at Morehouse School of Medicine in Atlanta, Georgia, to eight specialized centers at minority institutions and a network of research consortia at 28 leading neuroscience research programs, including centers in Alaska, Hawaii, and Puerto Rico. This program will help minority institutions develop state-of-the-art research programs in neuroscience and foster the research collaboration needed to address neuroscience problems that are relevant to those communities and regions served by the SNRPs.

Ensuring Access to Information Services: NLM plans to work with institutions around the country to use new information technologies to access health information that will help medically underserved patients with diabetes manage their disease and avoid complications. The Library will work with community health centers so that minority populations can benefit from the use of ClinicalTrials.gov–an easy-to-search database of more than 5000 clinical trials sponsored by NIH and others. NLM will also support Internet connectivity and access to health information for Indian reservations and villages that are currently underserved.

Diabetes in Minority Populations: NINR has expanded its efforts to improve the adherence of patients with diabetes to their treatment regimen as well as improve their quality of life. Current studies are evaluating barriers to treatment adherence in African American women with gestational diabetes–diabetes that develops in a pregnant woman and, if not treated, can cause serious problems for the mother and baby. Scientists are also testing a culturally specific intervention for Native Americans who have diabetes. A recent finding is that teaching coping skills to adolescents with diabetes led to better diabetes control and improved quality of life for them.

HEALTH EDUCATION AND OUTREACH

With the incredible rate of progress in biological research, it is now more important than ever that people understand the latest advances in medical research. Empowered by that knowledge, they will be able to take the best steps to improve their health, avoid diseases, or seek the best treatment for a disease. This section highlights a few of the new education and outreach programs at NIH.

Health Information for the Public: In FY 1999, NLM created MEDLINE*plus*, which provides easy access to a wealth of reliable health information written for the public, much of it from the NIH. The new service has information about more than 400 diseases and health conditions, extensive data on over-the-counter and prescription drugs, medical dictionaries and encyclopedias, and directories of hospitals and providers. One of the most important services of MEDLINE*plus* is providing the public and their health care providers with access to ClinicalTrials.gov, an easy-to-search online database of more than 5000 clinical trials sponsored by NIH and others. Users of MEDLINE*plus* are ensured total privacy, and usage has climbed to five million page hits a month.

Human Genome Education: NHGRI has designed and produced a kit to educate, engage, and excite the public about the human genome and genetics. The primary target audience is high school students, though a much broader use by college students, voluntary health organizations, and the general public is anticipated. The kit includes a multimedia CD-ROM, a wall poster of the genome, an informational brochure, and a video documentary. The kit was released concurrently with the publication of the complete description of the draft sequence of the human genome in February 2001.

Caregiving: The number of people providing long-term care outside of nursing homes and hospitals–institutional settings–is increasing rapidly due to the aging of the population, the limited access to high quality long-term care, and the expense of this care. A new NINR initiative on informal caregiving by unpaid family members and friends in the home or in a group home (assisted living) will support studies that test interventions to provide caregivers with the skills and information they need to meet complex demands, delay institutionalization, and promote a better quality of life both for caregivers and those they care for.

Aging and Exercise: Research supported by NIA and other NIH Institutes has shown that exercise can reduce the risk of heart disease, prevent osteoporosis, relieve moderate depression, and improve pain management. Exercise can also help to delay the onset of disabilities and life-threatening diseases. Thus, in 1999 NIA

launched a nationwide campaign to encourage older people to exercise by publishing a free manual, *Exercise: A Guide from the National Institute on Aging.* The Guide, which is based on scientific evidence, is intended to help people design their own exercise program so they will continue doing it and enjoy it. In an effort to reach more people and accommodate individuals' different needs, the book has been translated into an exercise video. NIA has distributed more than 360,000 copies of the exercise guide and 15,000 copies of the video.

Diabetes Outreach: NIDDK is expanding the existing National Diabetes Education Program (NDEP) to include a new initiative aimed at health care providers. The Institute also intends to launch a new National Kidney Disease Education Program, based on plans developed with the health organizations that are focused on diseases of the kidney.

Arthritis Education: NIAMS recently launched an initiative to reduce health disparities in diseases of the joints, muscles, bones, and skin among minority communities. The Institute has designed a model community-based program that will first address health issues related to arthritis and other rheumatic diseases in African Americans and Hispanics/Latinos in the metropolitan Washington, D.C. area.

Drug Education and Outreach: Enhanced funding has allowed NIDA to respond much more rapidly to its early warning system for emerging drug problems. In December 1999, NIDA launched an initiative in response to indicators suggesting an emerging epidemic of the use of club drugs–drugs used by teens and young adults in places like night clubs or bars. NIDA has since made considerable progress in determining the long- and short-term consequences of many so-called club drugs and in educating the public, scientists, and health professionals about the consequences of using club drugs, such as methamphetamine, MDMA, and GHB. NIDA wants to ensure that the public understands the residual effects that drugs such as methamphetamine and MDMA can have on the brain and body even after an individual stops using the drug. NIDA, in collaboration with community partners, has mailed a drug alert bulletin on club drugs to almost half a million physicians, treatment providers, nurses, and clinicians across the country. In addition, NIDA is providing fact sheets on club drugs through its fax-on-demand service, "NIDA Infofax," and distributing hundreds of thousands of postcard-like advertisements encouraging people to contact NIDA for research-based information. Public service announcements are also being aired nationally on this topic.

Curtailing College Drinking: The increasing news reports of alcohol-related deaths of college students have captured the attention of the Nation. A recent survey showed that almost half of all the college students who responded had engaged in binge-drinking. NIAAA has launched a special initiative to stimulate tests of college-based prevention strategies; as a result, 11 new studies are under way. In addition, NIAAA-affiliated researchers and university presidents are working together to address the context and consequences of college drinking and prevention strategies.