Summary of Research Activities by Key Approach and Resource

Research Training and Career Development

While the risk factors for heart failure—such as overweight, high blood pressure, and diabetes—have long been known, understanding its genetic origins is a much more recent pursuit and one of our most promising potential sources for novel drugs and therapies. Dr. Thomas Cappola was first drawn to this challenge during his medical residency when he began to study the molecular characteristics of the failing human heart. Over the next several years, NIH research training and career development awards helped provide him with the skills he would need to address such complex translational research questions. An opportunity to be a trainee on an institutional research training grant provided an in-depth exposure to patient-oriented research, and a clinical research curriculum award allowed his university to provide him with formal coursework in clinical investigation. Later support from the NIH loan repayment program permitted him to continue to pursue medical research without dwelling on the burden of repaying medical school loans, and an individual career development award provided protected time to further advance his research goals while working with a more senior investigator. This combination of NIH research training, loan repayment, and career development support has allowed Dr. Cappola to establish himself as an independent investigator pursuing his long-term research goal "to translate basic scientific discoveries into new approaches to treat and prevent heart failure," and in 2008, his use of genomic techniques to study heart failure was recognized with a Presidential Early Career Award for Scientists and Engineers.

Introduction

The biomedical and behavioral research conducted and supported by NIH—ranging from the very basic to the highly applied—has long been recognized as critical to advancing the quality of health care in the Nation and the world. As a result of NIH research, diseases such as AIDS, stroke, congestive heart failure, and diabetes increasingly are being treated or prevented more successfully. Further research undoubtedly will lead to new or improved medical therapies for a spectrum of diseases and disorders, but new advances in prevention, diagnosis, and treatment are dependent largely on the creativity, insight, and resources of the best scientists, and for these benefits to continue there must be a steady infusion of highly trained, well-equipped, and innovative new investigators. Research training is where cures begin.

NIH research training and career development programs are designed to prepare new minds for research and ensure that diverse pools of highly trained scientists are available in sufficient numbers and with appropriate expertise to generate new discoveries, meet the needs of rapidly moving scientific field, and bring science to bear on complex and evolving health care challenges. By sponsoring research training and career development programs in universities, teaching hospitals, NIH laboratories, and other research-intensive settings, NIH expects that trainees and newly trained investigators not only will be exposed to the latest research findings and techniques, but also will be prepared to rise to the challenge of emerging problems in medicine and health. To further ensure that the research workforce will be poised to respond to evolving national and international public health needs, NIH takes steps to encourage individuals to focus on targeted or under-researched areas such
as clinical and translational research, rare diseases, health disparities, and global health priorities.

The task of assessing and predicting research personnel needs across the entire spectrum—in the basic biomedical sciences, behavioral and social sciences, clinical sciences, oral health sciences, nursing research, and health services research—is daunting. Aligning the requisite expertise with public health needs is complicated by the evolving nature of biomedical, behavioral, and clinical research; the time required for research training; the international nature of research; and the mobility of the global research workforce. Preparing for a career in research generally requires a commitment of 8 to 10 years or more of predoctoral and postdoctoral training and career development; in the meantime, science is advancing, new diseases are emerging, and existing diseases are becoming better understood, diagnosed, and prevented.

In determining how best to sustain the continuing need for biomedical and behavioral scientists, NIH is guided by regularly scheduled analyses of the research workforce. Chief among these assessments are recurring studies conducted by the National Academies (NAS), which provide guidance on the fields in which researchers are likely to be required and on the number of new investigators needed in the basic biomedical, behavioral, and clinical sciences. NIH also routinely evaluates the outcomes of its training programs, comparing the subsequent research involvement of students and postdoctoral scholars who participate in NIH research training with their counterparts who were trained through other channels. Beyond such agency-wide assessments, individual ICs determine the need for new scientific personnel in mission-specific research areas through targeted evaluations, input from extramural investigators, and guidance from their national advisory councils.

NIH offers a broad range of research training and career development opportunities in its extramural and intramural research communities, through institutional training awards and individual fellowships, individual and institutional career development awards, continuing education, workshops, research grants, awards, and supplements to promote diversity or reentry into health-related research careers. Although its programs are largely directed toward graduate students and newly trained investigators, NIH offers a number of highly focused training and career development opportunities for individuals at other career stages, from college students to established scientists. NIH’s research training and career development programs cover a broad range of basic biomedical, behavioral, and clinical research, including the interdisciplinary junctures between fields.

All NIH training and career development programs foster and encourage a diverse pool of participants. NIH expects that efforts to diversify the research workforce will lead to the recruitment of the most talented scientists from all groups, improved quality of the educational and training environment, more balanced and broader perspectives in setting research priorities, enhanced ability to recruit and retain subjects from diverse backgrounds into clinical research protocols, and improved capacity to address and eliminate health disparities. In addition to NIH’s dedication to the inclusion of minorities and disadvantaged populations in the biomedical research workforce (also see the section on Minority Health and Health Disparities in Chapter 2), NIH is committed to the recruitment, retention, reentry, and advancement of women in biomedical research careers. Much progress has been made through the recent efforts of the NIH Director’s Working Group on Women in Biomedical Careers. In response to recommendations from the Working Group and others, NIH extended the length of parental leave offered to NIH-sponsored trainees and fellows in 2008, and introduced the option for part-time career development in 2009.

| NIH extended the length of parental leave offered to NIH-sponsored trainees and fellows in 2008 and introduced an option for part-time career development in 2009. |
Catalogs of Research Training and Career Development Activities

In response to the mandate under SEC. 403 (a)(4)(C)(iv) of the Public Health Service Act to provide catalogs of research training activities, included here are live links to spreadsheets of:

- Funded Kirschstein-NRSA and National Library of Medicine Institutional Research Training Grants, [FY 2008](#) and [FY 2009](#)
- Funded Kirschstein-NRSA and National Library of Medicine Individual Fellowship Awards, [FY 2008](#) and [FY 2009](#)
- Regarding postdoctoral scholars employed on research grants, NIH is implementing new reporting requirements. Grantees will be required to provide the names of all individuals associated with research projects for 1 or more months during the previous award year. In addition, individuals in postdoctoral roles will be required to establish and maintain personal profiles in the NIH eRA Commons. The Commons user ID for postdoctoral scholars will be reported in the list of individuals involved with NIH research projects. Information on postdoctoral scholars will be available for the next (FY 2010 and FY 2011) NIH Biennial Report.

Summary of NIH Activities

Extramural Programs and Progress: Research Training

Trans-NIH Programs and Initiatives

Training for a career in research typically requires a combination of specialized coursework and hands-on research experiences under the guidance of an established investigator. Most NIH-funded research training activities focus on predoctoral students and postdoctoral scholars and are provided either through training grants (T awards), which are awarded to institutions to support a coordinated program of training for a group of students or scholars, or fellowships (F awards), which directly support an individual's training. The principal NIH research training program for U.S. citizens and permanent residents, in size and breadth of coverage, is the Ruth L. Kirschstein National Research Service Award (NRSA) program. The goal of the NRSA program is to support promising students and postdoctoral scholars with the potential to become productive, independent investigators in fields relevant to NIH's mission. Training activities can be in basic biomedical or clinical sciences, in behavioral or social sciences, in health services research, or in any other discipline relevant to the NIH mission, and always include instruction in the responsible conduct of research. All ICs with funding authority award NRSA institutional research training grants and fellowships, except FIC and NLM. Reflecting the unique nature of their missions, the latter two ICs have distinct training authorities, separate from the NRSA program (see IC Programs and Initiatives below).

Through the NIH-wide program of NRSA institutional training grants and fellowships, NIH ICs supported nearly 16,400 graduate students and postdoctoral scholars at universities, teaching hospitals, and research centers in nearly every state in FY 2008. Institutional training grants form the core of NIH's research training programs, providing support to more than 80 percent of all NRSA program participants. Training grants play a particularly important role at the predoctoral level: approximately 60 percent of trainees are graduate students, often engaged in coursework and laboratory rotations in preparation for identifying an area of research for in-depth study. (See Appendix E for a breakdown on the demographics of NRSA participants and a summary of the number and type of doctoral degrees awarded to predoctoral NRSA recipients.)

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*Through the NIH-wide program of Ruth L. Kirschstein National Research Service Award institutional*
training grants and fellowships, NIH ICs supported nearly 16,400 graduate students and postdoctoral scholars at universities, teaching hospitals, and research centers in nearly every State in FY 2008.

Individuals interested in research training in universities or departments where there are no institutional training grants, as well as advanced students and postdoctoral scholars seeking tailored training opportunities, have the option of applying directly to NIH for an individual research training fellowship. NRSA fellowships provide recipients with valuable experience in initiating and testing their own research ideas before becoming full-fledged investigators.

Across NIH, NRSA training grants and fellowships help ensure the diversity of the research workforce by including features designed to provide research training opportunities to individuals from populations and backgrounds typically underrepresented in research (also see the section on Minority Health and Health Disparities in Chapter 2). Because part of the inherent challenge of recruiting talented individuals into research training programs is to have a pool of prepared applicants from which to draw, NIH offers undergraduate research training to honors students at selected institutions who have an explicit interest in a research career and intend to pursue postgraduate education leading to the Ph.D., M.D./Ph.D., or other combined degree. At the graduate and postdoctoral levels, NIH policy requires institutional training grant directors to take steps to recruit and retain trainees from underrepresented groups, including racial and ethnic groups and individuals with disabilities. Through the Ruth L. Kirschstein NRSA Individual Predoctoral Fellowship (F31) to Promote Diversity in Health-Related Research, NIH also provides graduate students from underrepresented groups with opportunities to pursue research training through individual fellowship awards.

The relative diversity of research training participants reflects NIH’s commitment to cultivating a broad-based scientific workforce. Among FY 2008 trainees and fellows who reported their race and ethnicity, 66 percent were white, 14.9 percent were Asian, 7.6 percent were African American, 7 percent were Hispanic, 1 percent were Native American, and 0.7 percent were Native Hawaiian or Pacific Islanders. More than 51 percent of trainees and fellows in FY 2008 were women.

NRSA training grants and fellowships may target broad-based or field-specific research training, depending on the needs identified by the administering IC. In recent years, this flexibility has allowed the NRSA program to respond to interest in greater integration of training activities across NIH to fulfill workforce needs shared by multiple ICs. The result has been a series of trans-NIH research training initiatives through the NIH Roadmap for Medical Research and other channels.

As the early Roadmap research training initiatives have matured, some have been selected for continuation and further expansion. The most notable of these are the Roadmap training grants and institutional career development awards in clinical and translational research that have been assimilated into Clinical and Translational Science Awards (CTSA). The CTSA program aims to accelerate the development of new treatments by transforming the way clinical and translational research are conducted. Creating multidisciplinary research teams that include physicians, basic scientists, statisticians, specially trained research nurses, informatics experts, and other specialists is central to this transformation. The CTSA program will grow through 2011 to serve about 60 academic sites, providing research training and career development opportunities in areas such as clinical research design, epidemiology, biostatistics, pharmacology, biomedical informatics, behavioral science, and ethics to more than 1,200 NRSA trainees and new investigators. (CTSA trainees are included in the NRSA data provided in Appendix E.)

In addition to its formal research training programs, NIH supports graduate and postdoctoral research experiences on research grants. Though not an NIH “program” per se, the impact of this support is significant. Graduate students and postdoctoral scholars acting as research assistants gain knowledge, skills, and experience that help prepare them for careers in research. To provide a better understanding of how many graduate students and postdoctorates contribute to research through roles as assistants,
NIH investigators will be asked to identify all research project personnel beginning in FY 2010. At that time, all postdoctoral scholars also will be expected to have established accounts in the Electronic Research Administration (eRA) Commons, a Web-based system through which NIH administers grants and collects demographic and other information about its community of investigators. With the implementation of these changes, NIH will have much greater understanding of the overall biomedical research workforce supported by its funding.

To provide a better understanding of how many graduate students and postdoctoral fellows contribute to research in their roles as assistants, and to the overall workforce involved in NIH research, NIH investigators will be asked to identify all research project personnel beginning in FY 2010.

IC Programs and Initiatives

Because each NIH IC has its own particular research mission, individual ICs are responsible for determining how the workforce needs identified by NAS and others apply to their specific scientific fields, selecting individuals and institutions for NRSAs or other research training awards to meet the needs identified, and reviewing annual progress toward building or enhancing capacity in the research workforce. Areas targeted for research training initiatives reflect the full array of NIH interests, from basic research training in biology and chemistry to clinical and translational research training in fields as distinct as cancer, infectious diseases, and aging. To ensure a supply of investigators attuned to the challenges of both research and patient care, a number of ICs also make awards for M.D./Ph.D. and other types of dual-degree training. The oldest and largest of these is the NIGMS Medical Scientist Training Program, which supports exceptional students pursuing an integrated program of graduate training in the biomedical sciences and clinical medicine.

While focusing on and supporting activities that address their respective missions and disease areas, ICs follow NIH-wide guidelines for NRSA research training and frequently collaborate to sponsor specific initiatives where there are overlapping interests or to stimulate interest in emerging fields. For example, eight ICs have partnered to support predoctoral training in biostatistics, through a program that integrates in-depth training in statistical theory and methodologies with basic biomedical, epidemiological, clinical, and behavioral research. In the area of neuroscience, multiple ICs support NRSA institutional training grants to provide broad neuroscience training for graduate students in the first and second years of study through the Jointly Sponsored Predoctoral Training Program in the Neuroscience. This program is affiliated with the NIH Blueprint for Neuroscience Research, a framework that brings together the 16 ICs and Offices that support neuroscience research and training, and provides a channel for coordinating their efforts. Other areas where ICs have come together to support research training on topics of joint interest include training at the interface of the behavioral and biomedical sciences, women's health, and bioethics.

NLM’s research training portfolio generally parallels the structure and requirements of the NRSA program and reflects NLM’s unique role as the primary Federal sponsor of biomedical informatics research and training. Like the ICs that provide NRSA research training, NLM prepares the next generation of informatics researchers and health information specialists through institutional grants (T15s), which support graduate and postdoctoral training in a broad range of topics, including health care information, bioinformatics, systems biology, imaging informatics, and public health informatics. NLM also offers a clinical informatics fellowship on the NIH campus designed to attract physicians and others to NIH to pursue research in clinical informatics. Unlike NRSA research training awards, some NLM training programs are open to master’s degree holders seeking further graduate-level coursework and hands-on training. (Also see the section on Disease Registries, Databases, and Biomedical Information Systems in Chapter 3.)

Reflecting the FIC mission to foster global health research and build research capacity in the
developing world, FIC institutional training grants (D43s) differ from those offered by the NRSA program or by NLM by allowing a broader range of participants and emphasizing the development of institutional partnerships and collaborations between U.S. and international universities and scientists. Most FIC research training programs focus on providing research training to individuals from low- and middle-income nations, but a number of selected programs provide opportunities to U.S. students and postdoctoral scholars interested in international health research. FIC training programs are contributing to the building of sustainable research capacity in the developing world to enhance prevention, treatment, and control of infectious diseases, including HIV/AIDS, TB, and malaria, which are major causes of morbidity and mortality in those regions. Other FIC programs target research training in the areas of clinical, operational, and health services research; noncommunicable diseases; population studies; environmental and occupational health; trauma and injury; bioethics; and informatics training for global health. In order to foster long-term scientific partnerships between U.S. and foreign investigators and build research capacity, most FIC training grants require a joint collaboration between a U.S. and foreign institution.

Reflecting the FIC mission to foster global health research and build research capacity in the developing world, FIC institutional training grants emphasize the development of institutional partnerships and collaborations between U.S. and international universities and scientists.

**Strength of Partnerships**

Research training involves collaboration between NIH and its grantee institutions in the form of shared responsibilities and funding. In making NRSA training grant awards, for example, NIH relies on universities and other sites that receive support to select the best trainees, determine the curriculum and other aspects of the training program, and provide mentorship and supplemental funding to participating students and postdoctoral trainees. Although NRSA fellowships are targeted to individual students or postdoctoral scholars, NIH expects the sponsoring institutions to provide fellows with experienced mentors and supplemental research funding support. In some targeted NRSA research training programs, NIH also partners with other agencies, private foundations, and professional societies to achieve shared research training goals.

Partnerships between NIH and the private sector are helping to accelerate research training in creative ways. For example, NIH has partnered with the Howard Hughes Medical Institute to develop new graduate student training programs at the intersection of the biological and physical sciences and engineering. Through a distance-learning partnership, NIH has joined with Duke University School of Medicine to offer the Master of Health Sciences in Clinical Research degree to fellows and others on the NIH campus; to date, more than 65 individuals have completed the program. (Also see the section on Clinical and Translational Research in Chapter 3.)

**NIH Training Program Evaluations and Assessments**

Since the NRSA program was established in 1974, NIH training programs have been regularly reviewed and evaluated. NAS has undertaken regular reviews of the medical research workforce and made recommendations for modifications in the size and focus of the NRSA program. In addition, NRSA program processes and outcomes are regularly assessed through recurring program evaluations and annually measured against several Government Performance and Results Act (GPRA) goals. These reviews have been coordinated by OER, which oversees the NRSA program. Increasingly, however, individual ICs also are undertaking evaluations of their specific NRSA and other research training programs.

**NAS Reviews.** Over the past 30 years, the NRSA program has been the subject of more than a dozen studies by NAS, which has provided expert guidance on the fields in which researchers are likely to be
required and on the number of new investigators needed in the basic biomedical, behavioral, and clinical sciences. The most recent NAS report on research training, published in 2005, noted that the NRSA program sets the standard for the entire research training establishment, attracting high-quality students into research and into fields of particular need.\(^{58}\)

The recurring nature of these NAS studies—the next will be issued in 2010—ensures that NIH research training programs reflect changes in science and research needs that inevitably occur over time. In recent years, NIH has followed recommendations from NAS committees for enhancing stipend levels, promoting the early completion of research training, and improving workforce data collection and analysis.

**Evaluations of NRSA Training.** Evaluations of the outcomes of NRSA research training routinely have found that graduate students participating in NRSA programs complete their degrees faster, are more likely to pursue research careers, and have greater subsequent success in research than do students not participating in NRSA programs.\(^{59}\) Similarly, a 2006 evaluation of NRSA postdoctoral training found that NRSA postdoctoral fellows were more likely to successfully pursue research careers. More than 60 percent of former NRSA postdoctoral fellows who subsequently applied for a major NIH research grant received funding, compared to 36 percent of other postdoctoral fellows.\(^{60}\)

**Government Performance and Results Act (GPRA) Goals.** Every year, NIH assesses NRSA research training outcomes and program management against two goals established under GPRA. In the first of these goals, NIH seeks to measure the quality of its programs and ensure that substantial numbers of trainees and fellows are retained in research careers by comparing the proportion of former NRSA trainees and fellows who apply for and successfully receive NIH research grant support against their peers. Subsequent NIH support is one of several measures that reflect the impact of NRSA research training on participants’ ability to successfully pursue and sustain a research career. To date, NIH has always met this GPRA goal, because NRSA trainees and fellows consistently outperform their counterparts.

The second training-related GPRA goal measures NIH progress in improving the efficiency of NRSA program management by developing and implementing the xTrain electronic system for appointing trainees to institutional training grants. Since its introduction in 2008, the number of universities using the xTrain system has tripled to more than 65, and in 2009 nearly 11 percent of training appointments were made electronically. Despite the substantial growth in institutions using xTrain, however, the number of appointments submitted electronically did not meet NIH’s GPRA goal for FY 2009. As a result, NIH plans to begin requiring institutions to use xTrain to submit appointments to selected training grants in FY 2011, and continues to expect that the new system will be fully implemented by FY 2012, with 100 percent of trainees appointed to training grants electronically rather than through paper appointment forms. Ultimately, xTrain is expected to save substantial staff time and eliminate data entry errors while increasing NIH’s efficiency and enhancing the integrity of data used for program monitoring and evaluation purposes.

**Institute and Center Training Evaluations.** In addition to scheduled NIH-wide assessments of programs coordinated through OER, individual NIH ICs undertake periodic, targeted evaluations to improve implementation and assess outcomes of their own training programs. Institute-specific evaluations typically focus on research training needs in particular areas and often are conducted by independent “blue ribbon” panels of scientific leaders from around the country. For example, in 2008, NIMH convened a workgroup, composed of Advisory Council and outside experts, to evaluate its research training programs and make recommendations for future directions. Other recent and ongoing IC assessments include evaluations of the outcomes of the NIDDK research training fellowships and career development awards, CTSA training grants, and NIAMS research training programs. Details of these evaluations are provided in the Notable Examples below.
Extramural Programs and Progress: Career Development

Given the pace at which science advances, novel techniques and methods are introduced, and new fields emerge, investigators need opportunities to fully develop their scientific expertise and stay up to date. NIH Career Development Awards (K awards) address that need. Collectively, more than a dozen types of K awards support investigators as they establish their research careers, pursue new directions, or dedicate themselves to training and mentoring the next generation of scientists. Like the T and F training awards, some career development awards support institutional activities to nurture careers and others directly support individual development.

Many career development awards are designed for researchers at specific career stages, particularly newly trained investigators. The NIH-wide Pathway to Independence Award accelerates the transition from mentored to independent research by providing a bridging mechanism, through which an initial 1- to 2-year mentored period is followed by an independent phase, during which awardees establish their own research programs and apply for independent research support. Other "mentored" career development awards provide support for a sustained period of protected time for intensive research career development under the guidance of an experienced investigator. The expectation is that, with this experience, awardees will be able to take the final steps toward establishing independent research careers and becoming competitive for new research project grant funding. For example, NIH supports the Building Interdisciplinary Research Careers in Women's Health program, which pairs junior faculty with senior investigators in an interdisciplinary environment. At the other end of the career spectrum, a number of ICs provide Senior Scientist Research and Mentorship Awards. These awards provide salary support for outstanding senior scientists and recognized leaders so that, through an interval of protected time, they can focus intensively on their research and mentor new investigators.

The NIH-wide Pathway to Independence Award accelerates the transition from mentored to independent research by providing a bridging mechanism, through which an initial 1- to 2-year mentored period is followed by an independent phase, during which awardees establish their own research programs and apply for independent research support.

Several career development awards are particularly designed to foster the involvement of clinicians in research. The Mentored Clinical Scientist Research Career Development Award continues a long-standing NIH commitment to provide support and protected time to individuals with clinical doctoral degrees so that they can engage in an intensive, supervised research career development experience. The award supports both didactic study and mentored research for individuals with a wide variety of clinical degrees, including the M.D., D.D.S., D.V.M., and Pharm.D. A related program, the Mentored Patient-Oriented Research Career Development Award, supports the career development of clinically trained professionals who have the potential to develop into productive, clinical investigators focusing on patient-oriented research.

Other career development programs target specific areas of science. Examples include the Career Enhancement Award for Stem Cell Research, which enables investigators to acquire new research
capabilities in the use of human or animal embryonic, adult, or cord blood stem cells, and the Mentored
Quantitative Research Career Development Award, which encourages investigators from quantitative
science and engineering fields to focus on questions of health and disease.

Coordination and Oversight by the NIH Office of Extramural Research

Much as NIH collaborates with grantee institutions in conducting research training, OER also partners
with ICs to coordinate and monitor awards for research training and career development across NIH.
With active input from the ICs, OER establishes and implements policies and guidelines for each of the
programs; determines broad national needs for basic biomedical, behavioral, and clinical research
personnel; coordinates NIH-wide evaluations; develops trans-NIH research initiatives in which NIH ICs
participate; and develops and maintains information systems to enhance program efficiencies. OER
convenes monthly meetings of the NIH Training Advisory Committee to provide an agency-wide forum
to identify and discuss issues related to research training and to provide opportunities to coordinate
activities pertinent to the review, administration, management, and evaluation of training grants and
fellowships.

Intramural Activities

The NIH intramural program provides opportunities for students, postdoctoral scholars, and clinicians to
gain research experience within the more than 1,100 NIH intramural laboratories. A multifaceted array
of programs provides a vibrant, scholarly environment and ensures strong research training
experiences for future investigators and the continued professional development of intramural
scientists.

Among the intramural program’s offerings are summer internships for high school, college, and
graduate students. Recent college graduates who plan to apply to graduate or professional school also
can spend a year engaged in biomedical research working side by side with NIH scientists. Current
graduate students can spend a summer, or even a year, as fellows engaged in biomedical research at
NIH. The Graduate Partnerships Program (GPP) enables students to pursue research at NIH toward
their degrees in partnership with a participating academic institution. By linking academic environments
with the breadth and depth of research at NIH, the GPP creates a valuable graduate experience, one
that purposefully focuses on skills of the future scientist and how discoveries will be made in the
decades ahead. The Clinical Research Training Program (CRTP) is a yearlong program designed to
attract the most creative, research-oriented medical and dental students to the NIH campus. CRTP
fellows spend a year engaged in a mentored clinical or translational research project in an area that
matches their personal interests and goals.

The Clinical Research Training Program is a yearlong program designed to attract the most creative,
research-oriented medical and dental students to the NIH campus. Fellows spend a year engaged in a
mentored clinical or translational research project in an area that matches their personal interests and
goals.

Training opportunities continue when scholars gain their graduate degrees. Year-round, NIH intramural
laboratories employ fellows from the United States and abroad, creating a thriving, multidisciplinary
intramural research community. The Postdoctoral Intramural Research Training Award provides the
opportunity for recent doctoral degree recipients, who are U.S. citizens or permanent residents, to
enhance their research skills in the NIH intramural environment. Trainees pursue both basic and clinical
research. A parallel program, Visiting Fellowships, serves foreign national doctoral-level scientists. For
clinicians, there are opportunities for residency and subspecialty training, including graduate medical
education (GME)-accredited programs (for program completion data, see Appendix E). These GME
programs enable research-oriented clinicians to weave research experience and training into their post-
medical school training.

In recent years, NIH’s intramural program increasingly has focused on helping graduate students and postdoctoral fellows develop their career skills. To ensure that intramural trainees and fellows can successfully advance in their careers, NIH offers courses in scientific writing and grant writing, as well as presentation and teaching skills. In addition, intramural trainees and fellows—indeed, all members of the NIH community—benefit from access to a plethora of NIH courses, seminars, and science career resources. For example, every day across the NIH campus there are scientific seminars and colloquia addressing the latest developments and discoveries in biomedical science; meetings of more than 100 Scientific Interest Groups that host forums and lecture series on cutting-edge issues of interest ranging from the Bioethics Interest Group to the Integrative Neural Immune Interest Group; and short- and long-term course offerings such as "Introduction to the Principles and Practice of Clinical Research" and "Principles of Clinical Pharmacology."

**NIH Loan Repayment Programs**

The NIH Loan Repayment Programs (LRPs) are a vital component of our Nation’s efforts to attract eligible doctoral-level professionals to research careers in fields of special importance—clinical, pediatric, health disparities, contraception and infertility, and AIDS research. To encourage qualified scientists to pursue research in these critical areas, the LRP provides financial assistance for educational debt in exchange for a 2- or 3-year research commitment. Nearly 1,600 program participants each year receive up to $35,000 annually in loan repayment and fulfill their commitments by conducting research in nonprofit, university, or government settings, or as an NIH employee. A 2009 evaluation of extramural LRP participants found that a substantial percentage remain in the research workforce after receiving a loan repayment award, and go on to receive subsequent research grants from NIH.

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A 2009 evaluation of extramural Loan Repayment Program participants found that a substantial percentage remain in the research workforce after receiving a loan repayment award, and go on to receive subsequent research grants from NIH.

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61 For more information, see [http://www.lrp.nih.gov/reports_and_statistics/index.aspx](http://www.lrp.nih.gov/reports_and_statistics/index.aspx)

**Conclusion**

The initiatives and program reviews highlighted in the next section demonstrate NIH's ongoing commitment to building and maintaining a biomedical, behavioral, and clinical research workforce that can uncover new knowledge that will lead to better health for all Americans.

**Notable Examples of NIH Activity**

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Trans-NIH Research Training Programs

Ruth L. Kirschstein National Research Service Award (NRSA) Program: The Kirschstein-NRSA program is the primary route through which NIH provides research training to students and postdoctorates and ensures that a workforce of skilled investigators will be available to meet the Nation's needs in biomedical, behavioral, and clinical research. The program offers two modes of research training:

- NRSA Institutional Research Training Grants support predoctoral and postdoctoral research training programs at domestic institutions of higher education. Institutional research training grants allow universities, research institutes, and teaching hospitals to select specific trainees and develop a curriculum of study and research experiences tailored to provide high-quality research training. The training grant award provides stipends and offsets the cost of tuition for appointed trainees.
- NRSA Individual Fellowships provide support to promising students and postdoctoral researchers with the potential to become productive, independent investigators. Before applying, prospective fellows must identify a sponsor, who will help them develop into independent researchers. The individual fellowship award provides a stipend to the recipient, plus additional funds for tuition and an institutional allowance, which can be used for travel to scientific meetings.

For more information, see http://grants.nih.gov/training/nrsa.htm
For more information, see http://grants.nih.gov/training/T_Table.htm
For more information, see http://grants.nih.gov/training/F_files_nrsa.htm
(E) (OER)

Training M.D./Ph.D.s and Other Clinician Scientists: Investigators who are trained as both clinicians and scientists have long played a unique and vital role in health-related research. To ensure a continuing supply of these specially trained clinician investigators, NIH supports dual-degree training through dedicated NRSA awards, providing M.D./Ph.D. training through institutional Medical Scientist Training Program (MSTP) grants, and M.D./Ph.D. and other types of dual-degree training through individual predoctoral fellowship awards. More than 1,000 students per year receive dual-degree training through NRSA training grants and fellowships. By integrating clinical and research training, dual-degree programs allow participating students to launch their research careers much more quickly than would otherwise be the case.

For more information, see http://www.nigms.nih.gov/Training/InstPredoc/PredocOverview-MSTP.htm
For more information, see http://grants.nih.gov/grants/guide/PA-09-232.html
For more information, see http://grants.nih.gov/grants/guide/PA-09-232.html
(E) (NIGMS, NHLBI, NIA, NIAAA, NIDA, NIDCD, NIDCR, NIDDK, NIEHS, NIMH, NINDS, ODP/ODS)

Training Activities of the Clinical and Translational Science Award Program: Clinical research requires unique skills in addition to those needed to care for patients, so academic health centers must equip members of clinical research teams with the special training and experience they
need to succeed. NIH expanded its clinical research training programs through Roadmap T32 and K12 programs that largely have been assimilated into Clinical and Translational Science Awards (CTSAs). Clinical research trainees learn the skills needed to cultivate multidisciplinary research team collaborations and design research projects to compete successfully for funding in a mentored environment. The CTSA training program already is providing more than 1,000 research training and career development opportunities in multiple individual disciplines. As mandated in Section 106 of the National Institutes of Health Reform Act of 2006 (Pub. L. No. 109-482), NIH will evaluate the outcomes and effectiveness of the CTSA training programs. The evaluation will include surveys of trainees, scholars, and mentors and will address pediatric clinical research training issues. In addition, the evaluation will conduct secondary analyses of pediatric clinical research training data collected by the CTSA program. This is part of a much larger comprehensive evaluation of the CTSA program as a whole. Each individual CTSA recipient also evaluates his or her own training activities, and the CTSA Education/Career Development Key Function Committee provides a forum in which best educational practices can be identified. The CTSA program was initiated in September 2006, so the long-term impact of the CTSA program will not be known for 7 or more years. However, short-term process milestones and intermediate outcomes are expected in 1 to 7 years. For example, the CTSA consortium defined training standards for core competencies in clinical and translational research. The consortium identified the skills, attitudes, and knowledge that investigators need to participate successfully in multidisciplinary teams of clinician-scientists.

- For more information, see http://nihroadmap.nih.gov/clinicalresearch/overview-training.asp
- For more information, see http://www.ctsaweb.org
- For more information, see http://www.ncrr.nih.gov
- This example also appears in Chapter 3: Clinical and Translational Research
- (E) (NCRR, Common Fund - all ICs participate)

**NIH Roadmap Training for a New Interdisciplinary Research Workforce:** As science has advanced over the past decade, it has become apparent that traditional organization of health research may, in some instances, slow the pace of scientific discovery. To foster changes in academic culture and interdisciplinary team approaches to research, in FY 2004, NIH announced several research training initiatives to provide interdisciplinary training to investigators at a range of career stages. One of these initiatives, the Interdisciplinary Health Research Training program, enabled institutions to develop postdoctoral training programs to provide newly minted scientists with interdisciplinary coursework and research training in fields outside their own, for example by integrating behavioral and/or social sciences with more traditional biomedical sciences research. A related program supported faculty interested in developing innovative and interdisciplinary courses, curricula, and education approaches. A final research training initiative, Training for a New Interdisciplinary Workforce, used a novel grant mechanism, the T90/R90, to support integrated interdisciplinary training at the undergraduate, graduate, and post-doctoral levels. Participants in this program all received training in at least two disciplines and had co-mentors from different fields. As Roadmap support for these programs nears an end, NIH announced in the summer of 2009 that the T90/R90 training and education award would be available for continued use by all NIH ICs.

- For more information, see http://nihroadmap.nih.gov/interdisciplinary/fundedresearch.asp
- (E) (NIDA, Common Fund - all ICs participate)

**Blueprint Interdisciplinary Research Training:** Under the auspices of the NIH Blueprint, interdisciplinary training programs have been established in computational neuroscience,
neuroimaging, and translational research in the neurobiology of disease.

- The computational neuroscience programs seek to attract undergraduate and predoctoral students from the physical, mathematical, and engineering sciences to neuroscience research, and to expand the training of neuroscience students in quantitative sciences. Students learn how to develop models of neural systems or processes, test them experimentally, and then use experimental data to refine the models.
- The neuroimaging programs support predoctoral students and summer research intensives and provide comprehensive training in the breadth of imaging techniques and their application to neuroscientific questions. The goal of these programs is to train the next generation of neuroimaging researchers in the limitations, advantages, and underlying principles of currently available neuroimaging modalities.
- The translational research programs support students at multiple stages of their careers. The programs are designed to cross-train students in basic and clinical neuroscience, focusing not on specific diseases but on the biological mechanisms that are shared across diseases.

These Blueprint training programs are successfully seeding the field of neuroscience with highly qualified graduate students, postdoctoral fellows, and faculty.

- For more information, see [http://neuroscienceblueprint.nih.gov/neuroscience_resources/training.htm](http://neuroscienceblueprint.nih.gov/neuroscience_resources/training.htm)
- This example also appears in Chapter 2: *Neuroscience and Disorders of the Nervous System* and Chapter 3: *Clinical and Translational Research*
- (E) (NIH Blueprint, NCCAM, NCRR, NEI, NIA, NIAAA, NIBIB, NIDA, NIDCD, NIDCR, NIEHS, NIGMS, NIMH, NINDS, NINR, OBSSR)

**Intramural Training and Education:** Working in collaboration with the NIH Fellows Committee, the Graduate Student Council, and IC training directors, the NIH Office of Intramural Training and Education has instituted several major annual events to serve trainees in the Intramural Research Program.

- The NIH Career Symposium provides an opportunity for NIH graduate students and postdoctoral trainees to learn about the various career opportunities available to them and to explore factors that lead to career success.
- The Graduate & Professional School Fair enables representatives of graduate and professional schools to recruit our college-age trainees. At the same time, workshops on writing personal statements, interviewing, and applying to positions are offered to the trainees.
- The International Opportunities Expo invites embassies, foreign funding agencies, and global corporations to recruit individuals interested in careers outside the United States.
- The NIH National Graduate Student Research Festival is a 2-day event held on the NIH campus to recruit the best graduate students to postdoctoral positions in the Intramural Research Program.

- For more information, see [http://www.training.nih.gov/](http://www.training.nih.gov/)
- (I) (OIR)

**The NIH Working Group on Women in Biomedical Careers:** The Working Group was established as a trans-NIH committee by the NIH Director in response to the National Academies report *Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering*, and to address the concerns of NIH intramural women scientists. The Working Group, co-chaired by the Director, NIH, and the Director, ORWH, is developing innovative strategies to promote the advancement of women in research careers at the NIH and throughout the extramural community. The
Working Group has held two national meetings: the National Leadership Workshop on Mentoring Women in Biomedical Careers, and Women in Biomedical Research: Best Practices for Sustaining Career Success, the recommendations from which are being incorporated into new initiatives. An RFA, Research on Causal Factors and Interventions that Promote and Support the Careers of Women in Biomedical and Behavioral Research, which will bring new insights for enhancing the efficacy of career development and mentoring programs for women, was developed and 14 awards were funded. Through the efforts of the Working Group, NIH extended the parental leave period for intramural trainees and NRSA recipients to 8 weeks and helped establish the Mid-Atlantic HERC, an online listing of positions at member institutions that is searchable using two sets of criteria to assist dual career couples. The NIH tenure clock has been extended to accommodate family leave, and a mechanism has been developed to employ a temporary lab manager to continue lab operations during extended leave of an intramural investigator. The Working Group also is developing initiatives to promote bioengineering as a career choice for women.

- For more information, see [http://womeninscience.nih.gov/](http://womeninscience.nih.gov/)
- For more information, see [http://www.midatlanticherc.org/](http://www.midatlanticherc.org/)
- (E/I) (ORWH, NCI, NCRR, NEI, NHGRI, NHLBI, NIA, NIAAA, NIAID, NIAMS, NIBIB, NICHD, NIDCR, NIGMS, NINDS, NINR, NLM, OCPL, OD, OER, OIR)

**Gauging the Role of Postdoctoral Researchers and Others in the Biomedical Workforce:** To gain a better understanding of the size and characteristics of the biomedical research workforce, NIH is taking steps to identify all personnel involved in NIH research grants. Beginning with annual progress reports submitted in January 2010, NIH-funded investigators will be required to report on all personnel who have contributed a month or more of effort to their research projects, including postdoctoral researchers. In addition, postdoctoral researchers supported by research grants will be required to establish NIH Commons accounts, which will provide NIH with the ability to collect and report demographic information, such as gender, race, and ethnicity. These changes will provide a more complete picture of the research workforce supported by NIH and will enhance future evaluations of NIH training programs.

- (E) (OER)

**Extramural Loan Repayment Programs:** Since they were established in FY 2000, NIH’s extramural loan repayment programs have helped retain more than 4,500 new doctorates in research careers by repaying some or all of their educational debt. Most of the new applicants are early career researchers (within 6 years of terminal degree) with significant educational debt; in the most recent award cycle, median educational debt for new M.D. applicants was $146,978. An early evaluation of the programs recently confirmed that program participants—the majority of which are M.D.s and M.D./Ph.D.s—are more likely to remain in the NIH-funded research workforce and to receive subsequent research grants from NIH.

- For more information, see [http://www.lrp.nih.gov](http://www.lrp.nih.gov)
- (E) (OER)

**International Bioethics Education and Career Development Award Program:** Few developing country institutions provide formal education in research ethics, and there are only a small number of developed country programs for advanced research ethics education/training focus in depth
on the internationally relevant aspects of research ethics. Therefore, few developing country scientists and health professionals conducting clinical or public health research have received extensive education and training in the principles of research ethics, international codes and legal aspects of ethical research, informed consent, elements of study design that affect the ethical conduct of research, and the ethical framework for provision of care and risk/benefit analysis for study participants. NIH's response to this was to develop a research bioethics training grant program that focuses on training ethicists who understand the fundamental principles and the cultural nuances of these principles as manifested in the guidelines being developed by other international organizations. Launched in March 2000, the International Bioethics Education and Career Development Award program is an institutional training grant that enables academic institutions to develop or expand current graduate curricula and training opportunities in international bioethics related to performing research in developing countries. Since 2001, more than 180 trainees from 40 developing countries have participated in the training programs.

NIH/FIC Clinical Research Training Scholars and Fellows Program: In response to a call from the President to invest in the economy by investing in global health research, as well as the growing interest in global health on U.S. graduate school campuses, FIC has expanded its Clinical Research Training Scholars and Fellows program, now in its fifth year, to provide early career mentored opportunities for U.S. postdoctorates and senior graduate students in the health sciences. The purpose of the program is to encourage the next generation of clinical research investigators to gain research experience working to address international health issues. The program provides new investigators with hands-on experience working in poor and transitional countries.

This program, which offers one year of mentored clinical research training at a site in the developing world, gives international opportunities to U.S. trainees, with the hope that such experiences during a formative period will encourage them to pursue careers in global health-related clinical research. The program, now expanded, provides support for clinical research training activities at the foreign sites, as well as a stipend for a foreign graduate student to be trained in tandem with the U.S. trainee during the clinical research year. Since the start of the program, the stipend amount has significantly increased to enable foreign site scholars to participate in the clinical research experience for a full year. In 2008, FIC expanded its commitment to the program and funded 33 U.S. scholars and 33 international scholars, eight more U.S. and nine more international scholars than the previous year.

Framework Programs for Global Health—A Signature American Recovery and Reinvestment Act Project: In response to the growing interest in global health on U.S. college campuses and to further build the multidisciplinary teams and curriculum needed to address global health issues, NIH has used some of its American Recovery and Reinvestment Act (ARRA) funding to enhance the Framework Programs for Global Health (FRAME). FRAME builds global health research capacity in the United States and in low- and middle-income countries by supporting the development of innovative, multidisciplinary global health programs. Through the FRAME program, institutions create administrative frameworks to network multiple schools (such as engineering, business, arts and
sciences, law, communications, public health, medicine, environmental studies, and others) on one or more campuses to address global health issues and to develop multidisciplinary global health curricula for undergraduate, graduate, and professional school students. Each program leverages and enhances currently funded global health projects at the institution and encourages new training opportunities, collaborations, and research. Institutions may choose to partner with other institutions anywhere in the world to plan joint curricula, interactive programs, and even joint degrees. Specifically, ARRA funding will bolster Framework Programs for Global Health at Dartmouth University, Yale University, the University of California at Irvine, and the University of New Mexico.

- For more information, see [http://www.fic.nih.gov/programs/training_grants/framework/index.htm](http://www.fic.nih.gov/programs/training_grants/framework/index.htm)
- For more information, see [http://grants.nih.gov/grants/guide/rfa-files/RFA-TW-08-001.html#Section1](http://grants.nih.gov/grants/guide/rfa-files/RFA-TW-08-001.html#Section1)
- (E) (FIC, NCI, NIBIB, NICHD, NINDS) (ARRA)

IC-Specific Programs and Initiatives

**Predoctoral Research Training in Biostatistics:** A workforce of biostatisticians with a deep understanding of statistical theory and new methodologies is vital to meet the biomedical, clinical, and behavioral research needs of the United States. With that end in mind, NIH has funded 13 predoctoral training programs in biostatistics to support 47 predoctoral trainees. The training program integrates biostatistical theory and evolving methodologies with basic biomedical research, including bioinformatics, genetics, molecular biology, cellular processes, and physiology, as well as epidemiological, clinical, and behavioral studies.

- (E) (NIGMS, NCI, NHGRI, NHLBI, NIAID, NIDCD, NIDCR, NINDS)

**Training for Cancer Research:** The Center for Cancer Training is preparing a workforce to advance cancer research through a scientifically integrated approach. The Center coordinates intramural and extramural research training, career development, and educational opportunities. The Interagency Oncology Task Force Joint Fellowship Program, an NIH-FDA partnership, supports development of new medical products by training scientists in research-related regulatory review. The Cancer Education and Career Development (R25T) Program supports career development for early career investigators transdisciplinary sciences, producing a generation of researchers cross-trained in disparity research areas and poised to conduct team research. The Calabresi Award in Clinical Oncology (K12) Program brings together clinicians and basic scientists to design and implement hypothesis-based therapeutic trials, promoting translation research findings from bench to beside. The Howard Temin Pathway to Independence Award in Cancer Research (K99/R00) assists early career basic scientists in transitioning from mentorship to independent research by providing funding to complete their fellowships, support their first investigator-initiated research programs, and launch their research careers. The Comparative Molecular Pathology Unit (CMPU) trains translational research investigators by incorporating interdisciplinary education in veterinary medicine with training in human biomedical research. Research Supplements to Promote Diversity in Health-Related Research create the foundation to attract and prepare qualified individuals from underrepresented and underserved populations and individuals with disabilities for careers in cancer research.

- For more information, see [http://www.cancer.gov/cct](http://www.cancer.gov/cct)
Predoctoral Training at the Interface of the Behavioral and Biomedical Sciences: The NIH Institutional Training Grant Program, “Training at the Interface of the Behavioral and Biomedical Sciences,” provides an interdisciplinary research training experience and curriculum for predoctoral trainees that integrate both behavioral and biomedical perspectives, approaches, and methodologies. Through coursework, laboratory rotations, and programmatic activities that reinforce training at this interface, the program aims to develop basic behavioral scientists with rigorous training in the biomedical sciences, who are available to assume leadership roles related to the Nation's biomedical, behavioral, and clinical research needs.

Informatics Research Training Programs: Exploiting the potential of information technology to augment health care, biomedical research, and education requires investigators who understand biomedicine as well as knowledge representation and decision support. NLM is the principal source of extramural funding for research training in the fields of biomedical informatics, supporting approximately 270 trainees at 18 institutional training programs throughout the country. NLM also provides intramural informatics research training opportunities for another 70 students, postdoctorates, and visiting scientists, as well as training and career development fellowships for health science librarians on the NIH campus and at academic health sciences centers across the country. Collectively, NLM's research training programs encompass health care informatics, bioinformatics, clinical research translational informatics, and public health informatics. Recent highlights and developments in informatics training include:

- A congressional supplemental appropriation for FY 2008 allowed NIH to add 26 NLM training slots.
- A Diversity Short-Term Trainee Program was implemented to improve the diversity of informatics trainees, with funding for 18 trainees at 7 training programs.
- Funds from the American Reinvestment and Recovery Act were committed to support an additional 56 2-year slots at 10 of its informatics training programs.
- A new Clinical Informatics Postdoctoral Fellowship was established to attract young physicians to NIH to pursue research in informatics.

AIDS International Training and Research Program: The AIDS International Training and Research Program (AITRP) began in 1988 as one of the first of a new generation of research training programs sponsored by FIC. This program supports HIV/AIDS-related research training to strengthen the capacity of institutions in low- and middle-income countries (LMICs) to conduct multidisciplinary biomedical and behavioral research to address the AIDS epidemic in their countries. This program provides training for scientists from LMIC institutions to strengthen HIV-related research and public health capacity.

For more information, see [http://www.nlm.nih.gov/training.html](http://www.nlm.nih.gov/training.html)
This example also appears in Chapter 3: Disease Registries, Databases, and Biomedical Information Systems
(E/I) (NLM) (ARRA)
health capacities at their institutions. AITRP has trained more than 1,500 trainees. Importantly, several partnerships between AITRP programs and the U.S. President's Emergency Plan for AIDS Relief (PEPFAR) were developed in 2008 and 2009. The training provided under the AITRP program targets a cohort of scientists who benefit from the critical thinking and problem-solving skills received through research training. These skills move them forward in their careers into leadership and policymaking positions in public health in their countries. Many PEPFAR programs are directed in-country by clinician/scientists who have received FIC-supported training. This training, therefore, is an important foundation for the long-term sustainability of the PEPFAR programs. There are many successful partnerships between PEPFAR country teams and FIC AITRP grantees in Zambia, Tanzania, and Cote d'Ivoire.

- For more information, see http://www.fic.nih.gov/programs/training_grants/aitrp/
- This example also appears in Chapter 2: Infectious Diseases and Biodefense
- (E) (FIC, NCI, NHLBI, NIAID, NICHD, NIDA, NIMH, OD)

**Research Training and Career Development for Veterinarians in Translational Biomedical Research:** Two recent reports from the National Academies, *National Need and Priorities for Veterinarians in Biomedical Research* and *Critical Needs for Research in Veterinary Science*, have confirmed the shortage of veterinarians involved in biomedical research. To address the shortage, NIH provides research training awards ("T" Awards) in biomedical research specifically for veterinarians and veterinary students. During FY 2008, more than 75 veterinarians received research training under the "T" mechanism. The mentored Career Development Awards ("K" Awards) to veterinarians serve as a bridge for postdoctoral fellows to become independent investigators. In FY 2008, 22 career development "K" awards were made to young veterinary investigators to increase the number of biomedical researchers with this expertise. Additionally, another initiative encourages the training of veterinarians in nonhuman primate clinical medicine at NIH-supported primate centers to address the shortage of clinical veterinary support for research primate colonies.

- For more information, see http://www.ncrr.nih.gov/career_development_opportunities/individual_training_grants/
- This example also appears in Chapter 3: Clinical and Translational Research
- (E) (NCRR)

**Summer Institutes to Train Behavioral, Social and Biomedical Researchers:** In addition to its formal research training and career development programs, NIH provides special opportunities for students and investigators to gain hands-on experience in research methodologies particularly relevant to behavioral and social science fields.

- Since 2000, NIH has sponsored the Summer Institute on Design and Conduct of Randomized Clinical Trials (RCTs) Involving Behavioral Interventions. Each year more than 200 applicants compete for 35 fellowships to participate in the 2-week course. Leading researchers and statisticians provide grounding in the principles underlying objective clinical trials; challenges posed by behavioral RCTs; alternative RCT designs; appropriate strategies for enrollment, randomization, and retention of participants; methods for monitoring, coordinating, and conducting RCTs; and strategies for appropriate statistical analyses of RCT data.
- In 2009, NIH initiated an annual Institute on Systems Science and Health, to encourage investigators to make use of modeling and related methodologies to tackle complex problems in behavior and health. The 46 participants in the week-long institute gained a broad overview of systems science methodologies and hands-on training in one of three systems science
methodologies (agent-based modeling, system dynamics modeling, or network analysis).

- For more information, see http://www.chronicdisease.org/l4a/pages/index.cfm?pageid=3851
- For more information, see http://obssr.od.nih.gov/training_and_education/annual_Hhsr.aspx
- For more information, see http://obssr.od.nih.gov/training_and_education/annual_Randomized_Clinical_Trials_course/RCT_info.aspx
- (O) (OBSSR, CDC)

Web-Based Learning Modules for Behavioral and Social Sciences Research: NIH is developing Web-based learning modules to enhance the conduct of behavioral and social sciences (BSS) research related to health. These courses provide interactive learning environments for behavioral, social, and biomedical scientists with the goal of facilitating team-based, multidisciplinary research.

- **Behavioral and Social Sciences Research Interactive Textbook.** NIH is supporting the development of an interactive, online course on research methods and tools for researchers engaging in BSS research on health-related topics. The project aims to demonstrate the potential of BSS research to enhance biomedical research, serve as a resource center for the most current and high-quality BSS research methods, reveal how to obtain authoritative answers to methodological questions easily and efficiently, and identify consistent and rigorous quality standards for the research community.

- **Evidence-Based Behavioral Practice.** Another project established a website and three training modules. A goal of the project is to develop online learning tools to help behavioral practitioners and students integrate research and practice in real-world conditions.

- **Genetics Educational Materials for Behavioral and Social Scientists:** An NIH-supported coalition is creating a Web-based educational program in genetics/genomics for the BSS research community. The program will help train scientists capable of working in interdisciplinary teams to improve our understanding of how interactions among genes, behaviors, and environments contribute to health and disease.

- For more information, see http://www.ebbp.org/
- (E, O) (OBSSR)

NINR Intramural Training Initiatives: Through a range of initiatives, NINR's intramural program bolsters the Institute's formal extramural research training programs and expedites the development of productive nurse scientists, many of whom also will serve as nursing faculty.

- The Summer Genetics Institute (SGI) is an intense, 2-month, full-time summer research training program for faculty, graduate students, and advanced practice nurses that has been supported annually by NIH since 2000. Hosted by the NINR Division of Intramural Research, the SGI features classroom and laboratory components that are designed to provide a foundation in molecular genetics for use in clinical practice and the research laboratory.

- For recently graduated, doctorally prepared nurse scientists, NIH sponsors the K22 Career Transition Awards, which are designed to facilitate the transition of postdoctoral trainees to independent research careers. Awardees receive up to 3 years of postdoctoral research training in intramural laboratories in Bethesda, Maryland, followed by 2 years of extramural support as they begin tenure-track faculty positions.

- Through its participation in the NIH Graduate Partnerships Program, NINR partners with schools of nursing to provide doctoral students with opportunities for up to 2 years of research training at the NIH. Participating students conduct research under the guidance of an NIH intramural investigator,
in areas such as symptom management, genetics, or end-of-life/palliative care.

- Finally, in 2009, NINR and the NIH CC, in association with the Bravewell Collaborative, began offering a 2-year fellowship for research in integrative medicine. The fellowship combines research experiences in the NIH intramural laboratories with instruction through the University of Arizona’s Program in Integrative Medicine.

  - For more information, see [http://www.ninr.nih.gov/Training/TrainingOpportunitiesIntramural/](http://www.ninr.nih.gov/Training/TrainingOpportunitiesIntramural/)
  - (I) (NINR)

**Informatics Training for Global Health:** As biomedical information has increased exponentially in recent years, computer-based tools have been developed to access and analyze this information and to aid the process of research design, data management, and data analysis. The sheer volume of data generated in many biomedical and behavioral research projects and in clinical trials can no longer be managed effectively without electronic help. Further, access to computers and the Internet is becoming commonplace in research institutions throughout the developing world. To take advantage of these tools, individuals with the advanced skills to use them are critically needed. However, despite the central role informatics plays in global health, many low and middle income country (LMIC) institutions have very few informatics experts and a very weak information technology infrastructure. There is a critical need to train local experts who are able to develop local research applications or modify existing platforms to provide tools that are appropriate for the needs, culture, and infrastructure of their institutions and countries. In response, NIH’s Informatics Training for Global Health program aims to develop human capital to meet global health challenges, to support the development of research hubs in LMICs, and to bolster the development of expertise in the use of information and communication technologies in support of research and research training.

  - For more information, see [http://grants.nih.gov/grants/guide/rfa-files/RFA-TW-09-001.html](http://grants.nih.gov/grants/guide/rfa-files/RFA-TW-09-001.html)
  - This example also appears in Chapter 3: *Technology Development*
  - (E) (FIC, NHGRI, NIBIB, NLM)

**Strength from Partnerships**

**Interdisciplinary Graduate Research Training: A Public-Private Partnership Between NIH and HHMI:** Howard Hughes Medical Institute (HHMI) and NIH have developed a joint initiative for Interdisciplinary Graduate Research Training. This innovative public-private partnership, begun in 2005, is intended to facilitate the development of graduate student training in emerging interdisciplinary research environments and to increase the number of interdisciplinary researchers working at the intersection of the biological and physical sciences and/or engineering. Funding for Phase I of the initiative was provided by HHMI, which awarded $10 million in 3-year grants to 10 institutions to pilot new and innovative ways to train interdisciplinary scientists. The second phase of this initiative, recently funded by NIH, provides support for graduate student training in interdisciplinary research. The training environments link the educational and research training missions of multiple schools and departments, including biology, chemistry, computational mathematics, engineering, materials science, and physics. They also have many innovative didactic and community-building activities, including "boot camps," team challenges, interdisciplinary courses and laboratories, courses on communication and collaboration, team mentoring, and interdisciplinary rotations, retreats, and seminars.

  - For more information, see [http://www.hhmi.org/news/112205.html](http://www.hhmi.org/news/112205.html)
  - For more information, see [http://grants.nih.gov/grants/guide/rfa-files/RFA-EB-08-003.html](http://grants.nih.gov/grants/guide/rfa-files/RFA-EB-08-003.html)
Clinical Research Training and Medical Education at the NIH CC: NIH develops, administers, and evaluates clinical research training and medical education initiatives that contribute to the professional growth of the clinical and translational research community, including medical and dental students, physicians in residency and fellowship training programs, established investigators, allied health professionals, and laypersons. The clinical research curriculum is offered at NIH and domestic and international locations. The curriculum consists of the "Introduction to the Principles & Practices of Clinical Research," "Principles of Clinical Pharmacology," and "Ethical & Regulatory Aspects of Clinical Research" courses as well as on-line courses for principal investigators. Extramural researchers have a new opportunity to access the rich training experiences available on the NIH campus via a "Clinical Research Management Sabbatical," which allows clinical investigators to come to the NIH CC to develop the leadership skills needed to create or enhance an optimal environment for conducting clinical research. The NIH CC also has partnered with extramural collaborators and industry to enrich its educational offerings. Via videoconferencing, Duke University School of Medicine offers NIH physicians and dentists an opportunity to receive a Master of Health Sciences in Clinical Research. The Clinical Research Training Program, a partnership supported by NIH and a grant to the Foundation for NIH from Pfizer Inc., trains 30 advanced medical and dental students annually in clinical or translational research.

For more information, see [http://www.cc.nih.gov/training/index.html](http://www.cc.nih.gov/training/index.html)

Paul B. Beeson Career Development Awards in Aging Research: The Beeson Awards, co-supported by NIH, the American Federation for Aging Research, and several other philanthropic concerns, offer 3- to 5-year faculty development awards to outstanding junior and mid-career faculty committed to academic careers in aging-related research, training, and practice. Beeson scholars receive funding and resources to pursue their innovative research; protected time for research; mentorship through their own institutions and through the program itself; and extensive networking opportunities. Since their inception in 1995, the Beeson award has provided nearly $80 million to 152 independent investigators, many of whom have gone on to become leaders in the field of aging research.

For more information, see [http://www.beeson.org](http://www.beeson.org)

NIH Training Program Evaluations and Assessments

Annual Assessments of Research Training: Every year, NIH monitors the effectiveness of its research training programs by analyzing the extent to which former Kirschstein-NRSA trainees and fellows remain engaged in biomedical research. Results of these annual assessments routinely have indicated that Kirschstein-NRSA postdoctoral trainees and fellows are more likely to remain active in biomedical research than their peers in the same fields, as indicated by the greater percentage applying for and receiving NIH research support within 10 years of their training.

Career Development for Physician-Scientists: NIH supports a number of institutional career development programs for physician-scientists at leading medical institutions across the country. Some of these programs are open to physicians of any specialty, while others are targeted specifically to physicians with particular specialties, such as pediatrics, medical rehabilitation, obstetrics-gynecology, or critical care medicine. NIH has tracked the career progress of physician-scientists who have participated in several of these programs. The results indicated that, depending on the specific program, between 60 and 85 percent of participants subsequently applied for an NIH grant, and between 50 and 75 percent of participants became a principal investigator on an NIH grant. Program participants received funding from all 24 award-granting ICs at NIH. The success rate for subsequent funding varied by the specific program, institution, sex, time since degree, and medical subspecialty. The findings will be used to refine program objectives and to target specific areas for improvement.

xTrain: As part of its commitment to electronic research administration, NIH has introduced a system to allow information on participants in institutional research training grants and career development awards to be transmitted to NIH electronically. Through this new system—xTrain, program directors electronically can appoint students and postdoctorates to research training and career development awards and report to NIH when their training is complete. Ultimately, xTrain will replace the paper appointment forms that have been used by NIH training programs since the 1970s and will help NIH manage its research training and career development activities more effectively. Since the introduction of xTrain in June 2008, more than 65 universities have begun using the system. By 2012, all appointments to NIH training grants and institutional career development awards are expected to be made via xTrain.

For more information, see http://era.nih.gov/services_for_applicants/other/xTrain.cfm

Evaluation of Extramural Research Training and Career Development Programs at NIAMS: NIAMS conducted an outcome evaluation to assess the success of postdoctoral research trainees who received NIAMS grants and awards through its extramural research training and career development awards program. Like other NIH training and career development grants and awards programs, the NIAMS program is intended to help ensure that a diverse and highly trained workforce is available to assume leadership roles related to biomedical and behavioral research. NIAMS's overall objective is to use a combination of institutional training grants and individual fellowships to ensure a continuing supply of well-trained scientists, prepared to conduct cutting-edge research related to musculoskeletal, skin, and rheumatic diseases. The specific grants and awards that were evaluated are the National Research Service Award (NRSA) institutional training grant (T32), NRSA individual research training grant (F32), and Mentored Career Development Awards (K01 and K08). While NIAMS uses other grant and award mechanisms, these awards were selected both because they represent a high proportion of the total dollars awarded, and because there is sufficient information available about recipients to assess their career progress over time. Overall, a working group of outside experts considered these programs to be successful in maintaining a highly trained workforce, and provided 10 recommendations for consideration. NIAMS has established an internal working group to review each of the recommendations carefully, and several key changes to the program already have been
Investing in the Future: 2008 National Advisory Mental Health Council Workgroup on Research Training: The National Advisory Mental Health Council convened a workgroup, composed of both council members and outside experts, to develop a framework outlining NIMH's research training priorities. The workgroup's goal was to identify the steps needed to develop a workforce equipped with the cutting-edge knowledge, skills, and perspectives that will accelerate the field of mental health research. The training report summarizes important characteristics of the future NIMH research workforce and considers three key issues: the diversity of the workforce; international students and postdoctoral scholars; and researchers holding dual M.D./Ph.D. degrees. The report includes recommendations for the future direction of NIMH-supported research training programs and initiatives, as well as those for program assessment and dissemination to the extramural research community. The report's recommendations were made with the hope that by developing an even stronger mental health research workforce, NIMH will increase the rate of innovative discoveries, and ultimately lead to improved treatment and functioning for people living with mental illness.

Review of the International Clinical, Operational, and Health Services Research and Training Award (ICOHRTA): NIH reviewed the first 5 years of the ICOHRTA program. The purpose of the review was to analyze program implementation, identify near-term outputs, and make recommendations for future improvements to the program.

Overall, the panel concluded that the program was successful and productive in its first 5 years. Notable accomplishments highlighting the effectiveness of the training program include the following:

- A total of 129 trainees from 18 low- and middle-income countries in 5 world regions have been associated with the program for at least 6 months, and many more individuals have participated in shorter-term training activities.
- Five former ICOHRTA trainees have competed successfully for NIH R01 awards, and one additional trainee is principal investigator on a Cooperative Agreement with the Centers for Disease Control and Prevention. Former trainees also collaborate on at least three NIH awards made to U.S. principal investigators since 2001, including an FIC Trauma award and a Fogerty International Research Collaboration Award.
- A total of 381 peer-reviewed journal articles are known to have been associated with ICOHRTA awards, as are an additional 47 nonpeer reviewed publications such as book chapters, books, and policy documents.
- ICOHRTA played a key role in several important national public health and policy projects.
**Evaluation of NIDDK Research Training Programs:** Each year, NIDDK evaluates the 5-, 10-, and 15-year outcomes of individuals who received either Career Development Awards (K awards) or Individual Postdoctoral National Research Service Awards (F32 awards). The most recent evaluation, conducted in 2008, included outcome data from individuals whose grants ended in 1993, 1998, and 2003. A total of 180 former F32 fellows and 139 former K awardees were included in the evaluation. The data showed that 45 to 58 percent (ranges reflect the high and low values of the groups evaluated) of the F32 postdoctoral fellows remained in research at the time of the evaluation. In addition, 50 to 60 percent of the fellows had applied for additional NIH funding; of those who applied, 55 to 68 percent were successful. Among K awardees, 62 to 85 percent remained in research at the time of the evaluation. Furthermore, 71 to 85 percent of the K awardees had applied for further NIH funding, and 75 to 81 percent of those who applied were successful. Data on current funding status and on the number of publications during the last year—and the subsequent 2 years—of the F32 or K award funding also were collected, along with the current position of each awardee, when available. Overall, NIDDK concluded that the trainees have been successful with respect to scientific progress, continuation in research, and applying for funding. NIDDK uses these data to guide its research training programs, which aim to advance research progress through the training of investigators in research relevant to diseases within the Institute’s mission. NIDDK also has discussed results of training program evaluations with its Advisory Council for additional input.

- (O) (NIDDK)

**Trans-NIH Extramural Career Development Programs**

**Research Career Development Programs:** One of the most challenging transitions in any research career is the progression from postdoctoral trainee to independent scientist. NIH has long used the Research Scientist Development Award (K01) to foster the successful transition of individuals who hold a research or health-professional doctoral degree or equivalent. To support the transition of junior-level clinically-trained investigators, NIH also offers the Mentored Clinical Scientist Development Award (K08) and the Mentored Patient-Oriented Research Career Development Award (K23). For postdoctoral fellows seeking to transition to faculty positions, awards such as the Career Transition Award (K22) and the Pathway to Independence Program (K99/R00) provide mentoring, protected time, and financial support to ease the transition to faculty positions. At the institutional level, NIH offers several Mentored Clinical Scientist Development Awards (K12) that provide support to newly trained clinicians at an institution who are developing their independent research skills and experience. Other specific career development awards are tailored to meet the needs of different research areas and recipients at different career levels.

- For more information, see [http://grants.nih.gov/training/careerdevelopmentawards.htm](http://grants.nih.gov/training/careerdevelopmentawards.htm)
- For more information, see [http://grants.nih.gov/grants/guide/pa-files/PA-09-040.html](http://grants.nih.gov/grants/guide/pa-files/PA-09-040.html)
- For more information, see [http://grants2.nih.gov/grants/guide/pa-files/PA-09-042.html](http://grants2.nih.gov/grants/guide/pa-files/PA-09-042.html)
- For more information, see [http://grants2.nih.gov/grants/guide/pa-files/PA-09-043.html](http://grants2.nih.gov/grants/guide/pa-files/PA-09-043.html)
- For more information, see [http://grants2.nih.gov/grants/guide/pa-files/PA-09-036.html](http://grants2.nih.gov/grants/guide/pa-files/PA-09-036.html)

- (E) (OER)

**Building Interdisciplinary Research Careers in Women's Health (BIRCWH):** The Building Interdisciplinary Research Careers in Women’s Health (BIRCWH) program is an interdisciplinary, mentored, career development initiative that supports junior faculty men and women who are conducting research in women's health. Each scholar has at least two mentors from different disciplines that are part of their interdisciplinary mentoring team. The BIRCWH is co-funded by the NIH Office of
the NIH Director, several NIH ICs, and the Agency for Healthcare Research and Quality (AHRQ). To date, 50 BIRCWH programs have been established at 38 institutions and there are currently 26 active BIRCWH sites. More than 378 scholars have participated, of which 79 percent are women. Scholars have published more than 1,300 publications and have successfully competed for 282 NIH research grants. BIRCWH plays a critical role in maintaining the pipeline of junior faculty who are available to conduct women's health research.

- For more information, see [http://orwh.od.nih.gov/interdisciplinary/bircwhmenu.html](http://orwh.od.nih.gov/interdisciplinary/bircwhmenu.html)
- (E) (ORWH, AHRQ, NCI, NIA, NIAAA, NIAMS, NICHD, NIDA, NIEHS, NIMH, ODP/ODS)

**Disparities Research and Education Advancing Mission Career Transition Award:** This award program facilitates the transition of early-stage investigators working in health disparities or areas that address health disparity conditions and populations from the mentored stage of career development to the independent stage of investigator-initiated health disparities research. The program provides an opportunity for investigators to develop solid research skills during the initial period of up to two years of study and research within the NIH Intramural Research Program. The award may also include a follow-on period of up to three years of salary and mentored research support at the candidate’s current institution or organization or an academic or research grantee institution of the candidate’s choice. This period of extramural support will facilitate the transition to independence as a researcher in health disparities research.

- For more information, see [http://grants.nih.gov/grants/guide/rfa-files/RFA-MD-10-001.html](http://grants.nih.gov/grants/guide/rfa-files/RFA-MD-10-001.html)
- (E) (NCMHD)