

Signature Programs

Neuroscience

The goal of the neuroscience initiative is to create a nationally recognized center of research into the biological bases of brain function and dysfunction in the service of providing new treatments for prevalent nervous system disorders. Areas of focus will include: neurodevelopmental disorders (autism spectrum disorder and schizophrenia), neurodegeneration and nervous system injury (multiple sclerosis, Parkinson's and Alzheimer's diseases, spinal and brain injuries), cognitive and sensory disorders, and motivational disorders (addiction, obesity). Funding to support this program will be sought from the NIH BRAIN initiative and other public and private entities.

The program will be led by the director of the new Brain Health Institute (BHI), which will be the home for this initiative. BHI was created in 2013 as an RU-New Brunswick and RBHS partnership. BHI will work collaboratively with other Rutgers entities with appropriate neuroscience interests in order to achieve the program's objectives. These include, in particular, the to-be-created Rutgers University Consortium in Autism and the Center for Molecular and Behavioral Neuroscience (RU-Newark). BHI will also work with RU-New Brunswick to hold a multi-day conference on computational cognitive neuroscience, planned for FY 2015, to which national experts who utilize biological, psychological, and computational approaches to conduct brain research will be invited.

The selection of the focus areas was based on an analysis of strengths at Rutgers currently, as well as the recognition of common nervous system disorders with a large need for novel treatments. An analysis of publications from Rutgers faculty over the past five years in neurodegeneration, dysfunction and aging revealed 103 papers related to Parkinson's disease, 101 papers related to Alzheimer's disease, and 90 papers related to multiple sclerosis. Of these, Parkinson's disease and multiple sclerosis were identified with the greatest strength in grant funding: 11 grants were identified that focused on Parkinson's disease (est. \$6.4 million) and 24 on multiple sclerosis (est. \$10.1 million), whereas three grants focused on Alzheimer's disease (\$1.6 million). In addition, other investigators are studying processes related to central nervous system degeneration and aging (19 PIs; 28 grants) or adult brain function (19 PIs; 32 grants). Several clinical trials were identified in the fields of multiple sclerosis and Parkinson's disease.

Analysis of publications from Rutgers faculty over the past five years in loss of neural function during development revealed 37 papers in the area of autism and 54 papers in schizophrenia. Forty-one currently funded or recently closed grants associated with this sub-area were identified: 15 grants directly related to autism (est. \$10.5 million) and seven grants (est. \$5.4 million) directly related to schizophrenia. Additional investigators are studying processes related to developmental disorders or injury (15 PIs; 19 grants). New Jersey also supports grants in autism, including one program project grant, indicating their endorsement of this area.

Analysis of publications from Rutgers faculty over the past five years in loss of neural function after injury revealed 77 papers in spinal cord injury, 45 in brain injury, and 113 in stroke. The greatest strengths in grant funding were in spinal cord injury and traumatic brain injury. Eighty-five currently funded or recently closed grants in this area were identified: 50 directly related to spinal cord injury (est. \$18.1 million) and 16 related to traumatic brain injury (est. \$12.3 million). The remaining grants encompassed more general themes within strategies to promote regeneration (8 PIs; 19 grants). The State of New Jersey has supported a number of the grants on both spinal cord injury and traumatic brain injury, including two program project grants on traumatic brain injury (both basic and clinical studies). Several clinical trials and private donations were identified in spinal cord injury.

Comparisons of publications in these areas of strength were conducted with peer institutions in New York, Connecticut, Philadelphia, and New Jersey, as well as institutions in the Big Ten. In the area of Parkinson's disease, Rutgers ranked 5th in publications regionally and 4th in the Big Ten. An analysis of multiple sclerosis-related publications revealed that Rutgers already is "first in class" both regionally and in comparison to the Big Ten. In spinal cord injury, Rutgers ranked 4th regionally and 6th in the Big Ten in publications. An analysis of publications associated with TBI revealed that Rutgers is 5th both regionally and in the Big Ten. Spinal cord injury, traumatic brain injury, and autism are particularly attractive because the State of New Jersey supports Commissions on Spinal Cord Injury (NJCSCR) and Brain Injury (NJCBI) and the Governor's Council on Medical Research and Treatment of Autism that have provided significant grant funds to many Rutgers faculty members.

Other areas that represent major clinical problems with very limited therapies are ripe for development at Rutgers. Cognitive neuroscience is the study of brain mechanisms of high-level mental function that are critical for human experience but are primary contributors to the morbidity of many neural disorders including Alzheimer's and Parkinson's diseases, autism, and schizophrenia. Rutgers' strengths in cognitive neuroscience can be linked to extensive expertise in behavioral neuroscience and neuroimaging. Development of new therapies for these disorders requires an understanding of complex cognitive phenomena and the way in which altered neural function gives rise to cognitive deficits in such diseases. Motivational disorders also rank high in the need for new clinical treatments. Addiction and obesity are rampant nationally and internationally, but little is known about the brain substrates that lead to these disorders. Strengths at Rutgers in both of these and related areas indicate that further development would be fruitful for developing novel treatments for these disorders. New therapies require research focused on mechanisms of motivated behavior, which are at the root of these behavioral problems.

A further focus for BHI will be to utilize new techniques in basic neuroscience to develop novel therapies for brain and spinal disorders. Over the past seven years, developments in viral vector neurotransduction, optogenetics, and chemogenetics (designer receptors), among other areas, are revolutionizing neuroscience. These new methods have proven effective in altering brain function and dysfunction in highly specific ways in animal models, indicating that such methods may lead to a new generation of neurotherapeutics. Indeed, viral vectors are already being used in clinical trials to treat Alzheimer's and Parkinson's diseases by expressing growth factors to halt degeneration of neurons in the basal forebrain and midbrain. Similar viral vectors can be used to express opsins or designer receptors in a cell type-specific manner to allow control of selective populations of brain or spinal neurons with unprecedented specificity. This will allow new therapies, based upon knowledge from basic neuroscience research, with many fewer side effects compared to almost any current treatment. Rutgers can take the lead in the development of such new therapeutics.

The neuroscience initiative's ultimate mission will be to unite and expand the large Rutgers neuroscience community and become "best in class" nationally within the identified focus fields. The program will have three major goals:

- to create research programs focused on the biological underpinnings of healthy central nervous system functions and dysfunctions associated with the above disorders;
- to develop new treatments for these disorders based upon this research and new neuroscience tools; and
- to establish a rich neuroscience resource in New Jersey that educates the public, clinicians, faculty, and students, as well as state, national, and international health officials.

By studying different disorders in parallel, we can identify commonalities for the underpinnings of disease. Moreover, the new neuroscience techniques that will be used as the basis for novel neurotherapeutics will be applicable across all of these and other neural disorders. The goal is to

identify the genetic, environmental, and other aspects related to neuropathology and repair so that effective strategies can be developed for prevention and treatment.

The newly formed RBHS complementary programs will provide significant synergies. The informatics group will assist in state-of-the-science imaging data acquisition and storage as well as with increased communication capabilities; the Clinical Research Group will support the development of a clinical and translational science award that will support clinical trials arising from basic research; the public health group will advise in the fields of epidemiology, biostatistics, and quantitative methodologies; and the drug discovery group will assist in target identification which will fuel translational research and coordinate institute studies with New Jersey biopharmaceutical companies and the Rutgers Biopharma Educational Initiative.

The following will be goals for year 1:

- recruit a leader for the university-wide BHI, who will also serve as leader of the RBHS signature program;
- begin recruiting senior faculty (ideally, one for each identified focus area) with established track records of extramural funding to provide leadership for each initiative sub-area (faculty to arrive by year 2);
- establish administrative support for the program;
- evaluate and plan for state-of-the-science imaging at needed sites and other needed cores (supported by equipment grants by faculty and a Rutgers campaign to raise funds), which will be monitored by core directors with the goal of becoming self-sufficient from user fees by years 2-3;
- strengthen alliances with principal teaching hospitals (level 1 trauma centers: NJMS and RWJMS, Kessler Rehabilitation Institute, JFK Johnson Rehabilitation Institute, and Children's Specialized Hospital) by identifying one collaborating faculty member affiliated with each site who will work with the institute leadership to promote identification of research questions and recruitment of clinical trial participants from this site (descriptive statistics of participant involvement from each site and faculty input from each site will be collected to monitor the effectiveness and strength of these alliances); and
- establish stronger liaisons with the biotech and pharmaceutical industry in collaboration with the drug development and clinical research complementary programs (biotech and pharmaceutical companies will be introduced to the institute through an invitational "meet-and-greet" the institute faculty and staff open house, followed by designation of a Rutgers drug development faculty member to be the ambassador of the institute to that company regarding drug or biotech research and development).

To facilitate communication, one to two-day strategic planning conferences will be conducted. These will include Rutgers faculty, staff, students, and multidisciplinary collaborators from various Rutgers schools, community and professional organizations, foundations, and governmental agencies. Teams will be developed for each of the focus areas, which will advise on goals, objectives, and outcome measures specific to each focus area; processes will be put in place, including telecommunication capabilities from all sites, to coordinate communication among international, national, and state educational, clinical, and research neuroscience programs, using the expertise of IT and in collaboration with public health experts; a website will be developed with a virtual resource center along with directory of all staff, faculty, clinicians, and researchers involved in the program in collaboration with the complementary programs; and a Telehealth grand rounds neuroscience seminar series will be planned to bring leaders external to Rutgers to speak and meet with Rutgers scientists in the BHI areas of focus.

The following will be goals for year 2:

- recruit the first group of junior faculty hires to fill some of the gaps in viral vectors and plasmids, cognitive neuroscience, motivational neuroscience, genetics, neuropathology, imaging, clinical research, and translational research especially in the area of drug development (faculty to arrive in years 2-3);
- establish an internal neuroscience study section to support new grant applications;
- establish a pilot grant mechanism that funds collaborative projects;

- form affinity groups to enhance collaborations across campuses and with external entities;
- apply for federal, state, and private foundation grants to fund individuals, multi-PIs, and training grants;
- establish an endowed one-year fellowship to support post-neurology residency training of physician-scientists and a three-year endowed fellowship to support training of an MD/PhD student;
- establish strong drug discovery teams to foster translational/clinical trials in collaboration with the drug development and clinical research complementary programs;
- establish access to core resources in key areas such as biostatistics, epidemiology (public health complementary program), data management, clinical trials (clinical research complementary program), and bioinformatics (informatics complementary program);
- provide regularly scheduled “Telehealth Grand Rounds” for neuroscience researchers, clinicians, educators, and advocates within the BHI;
- organize symposia on each of the areas of focus with invited expert speakers (the director will meet with the president of the New Jersey chapter of the Society for Neuroscience, public health professionals, as well as with other stakeholders to discuss how outreach activities can be best coordinated); and
- identify continuous quality indicators for best practices in clinical care, education, and quality of life for persons with neurodegenerative conditions, neural injury, motivational or cognitive disorders, and neurodevelopmental disabilities.

The following are goals for year 3:

- continue to recruit faculty hires to fill gaps in viral vectors and plasmids, cognitive neuroscience, motivational neuroscience, immunology, genetics, neuropathology, imaging, clinical research, and translational research especially in the area of drug development; continue to apply to NIH for individual (R01, R21), training (T32, F30), program project (P01), exploratory (P20), specialized center (P50), and center core (P30) grants from the relevant NIH institutes (at least 20 NIH grant applications per year, including all institute individual, training, and collaborative grants);
- and formulate state and national policy efforts to address earlier screening and evidence-based diagnosis of neurodevelopmental disorders (autism), as well as earlier recognition of neurodegenerative and neural injury disorders.

Also, by the end of year 3, the Brain Health Institute director and/or program faculty will be serving on state, federal, and international committees.

The following is planned for year 4:

- develop curricula and training guide toolkits for pre- and post-graduate health profession education regarding cognitive function and dysfunction, motivational disorders (addiction and obesity), neurodegeneration, neurodevelopmental disorder, and neural injury diagnosis and care (faculty development for this curricula development starts in year 1 or 2);
- policy center faculty will serve as experts for local, state, national, and international consultation; and
- continue applying for individual (R01, R21) and collaborative NIH grants (P01, P20, P50, P30) and for centers of excellence grants directed to autism, multiple sclerosis, Parkinson’s disease, spinal cord injury and traumatic brain injury where available.

In year 5:

- an application will be submitted for an NIH-funded comprehensive center grant (P60);
- and state, national, and international policy will be set to increase earlier screening, diagnosis, and referral for neural injury (traumatic brain injury, spinal cord injury), neurodevelopmental disorders (autism), cognitive, motivational, and neurodegenerative disorders (multiple sclerosis, Parkinson’s disease).

By the end of year 5, program faculty will:

October 13, 2014

- receive multiple NIH research center-related awards, positioning Rutgers among the top ten, NIH-funded U.S. research centers.
(<http://report.nih.gov/award/index.cfm?ot=&fy=2014&state=&ic=&fm=RC&orgid=&distr=&rfa=&pid=#tab2>).
- receive more than double the current funding from federal and state grants;
- increase the number of publications (at least 10 articles per year from at least three focus areas of the institute or at least 30 articles/year in years 3-5);
- have established cross-communication and increased campus-wide collaborations (these collaborations will be measured quantitatively using the number of Rutgers schools, departments, faculty, and staff involved in institute initiatives over each of the five years, and qualitative assessments will be conducted semi-annually by institute staff to identify strengths, weaknesses, and barriers to successful collaborations);
- be recognized at the state and national levels as a critical resource to inform public policy; and
- be recognized as best in class regionally and within the Big Ten in neuroscience.