



Information for Post-Doctoral Fellows and Applicants

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National Institute on Disability and Rehabilitation Research (NIDRR)
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ADVANCED REHABILITATION RESEARCH TRAINING PROGRAM

Information for Fellows and Applicants

The University of Medicine and Dentistry of New Jersey/New Jersey Medical School, in conjunction with the Kessler Foundation Research Center, is pleased to offer an advanced, multidisciplinary training program in medical rehabilitation research.

Introduction

This Research Training program is designed to respond to the shortage of doctoral-level investigators to work on important, unsolved problems relevant to the ever-increasing physically disabled population. The Program is designed to solicit pre- and postdoctoral applicants both from biomedical sciences and from clinical rehabilitation disciplines, including fields such as biomechanics, physiology, psychology, psychiatry, neurology, nursing, physical therapy, occupational therapy, and rehabilitation engineering. The program particularly seeks to attract applicants from the field of physical medicine rehabilitation, rehabilitation sciences and rehabilitation engineering, where the need for research training is intense. The program has several innovative features:

- Self-direction. Upon the initiation of the fellowship, the fellow, in collaboration with his or her mentors, constructs a research training plan. This research training plan is designed to guide the fellow through the fellowship years. The essence of advanced training is to nurture the spark showing in promising young investigators, who will present ideas and goals of their own in response to an environment rich in research opportunities.
- Mentors from other areas of biomedical and social research. Though most mentors are experienced rehabilitation mentors, a number of potential mentors are highly experienced scientists in other disciplines that logically have the potential to make a great contribution to rehabilitation. By working with talented Research Fellows, some of these mentors are likely to be drawn into a new program of research -- on rehabilitation. Similarly, fellows benefit significantly through their work with mentors outside of the rehabilitation field, allowing them to examine their work from alternative angles.
- Team building: a central task for the Fellow. Just as clinical practice in rehabilitation is based on the multidisciplinary team, productive rehabilitation research requires a research team. Successful Research Fellows will spend their subsequent careers creating and working in research teams. A core feature of our Advanced Research Training Program is the provision of Fellows with a formative experience in developing their own research teams.
- Prior commitment to rehabilitation research. Applicants will be screened closely for their commitment to research; a commitment statement will be required. A likelihood of placement in an academic/research setting is a criterion for acceptance, and the individual's Research Training Plan must include plans for a post-Fellowship placement in an academic/research setting.
- Use of residency as a recruitment and evaluation tool. For the M.D. resident training track, residents are selected from nationwide applicants on the basis of their research promise. Their abilities will be seen firsthand as they participate in required research training activities.
- Beyond institutional boundaries. Though the emphasis is on faculty at the University of Medicine and Dentistry of New Jersey (UMDNJ), Fellows will be told that it is their task to work with the best scientists in the New Jersey - New York Metropolitan area that they can.

The Fellowship and Research Experience

Each Fellowship will be based on an individualized Research Training Plan written by the Fellow with the advice and consent of his/her mentors. In general terms, each Fellowship will consist of:

- Intensive work and training with a team of mentors who are highly experienced in: a) rehabilitation research; b) a special discipline or topic relevant to rehabilitation; and/or c) in a necessary methodological tool. Some Fellows will spend most (up to 2/3) of their time with a single Primary Mentor who is an extremely qualified senior investigator, while others will split their time between members of their mentoring team. A mentoring team may consist of up to three Primary or Associate Mentors with substantial influence and the power of consent to the Fellow's Research Training Plan, although a fellow may have directed study or experience with a number of other persons (Assistant Mentors).
- Formal coursework or directed study to remedy deficiencies and master a) advanced knowledge of rehabilitation, b) a scientific or medical specialization area, c) a statistical or research design skill, and d) a research tool.
- Attendance and participation in conferences, lectures, and seminars offered by the Department of PM&R, by other departments at UMDNJ, Kessler Foundation Research Center, Rutgers and by other institutions in New Jersey and the New York Metropolitan Area. The Fellow will be exposed to rehabilitation administration and encouraged to participate in a grant-writing project to enable future funding.
- Above all, research experience in the laboratory or office of more senior investigators, and completion of published research projects and a submission of an NIH grant application.

Productive research training will be possible in a wide variety of areas by combining the abilities of researchers skilled in diverse areas relevant to rehabilitation. Outstanding single-subject areas include: neuropsychology and neuropsychological recovery processes, neuroscience, functional assessment, spinal cord injury (SCI), traumatic brain injury (TBI), outcome and effectiveness research, and physiatrist.

Coursework and guided study requirements: three areas. This Fellowship program provides an opportunity to either broaden Fellows' skills by remedying deficiencies in important areas relevant to their type of rehabilitation research or to increase the depth of their knowledge or skill in an advanced topic. At a conceptual level, we believe that Fellows beginning a career in rehabilitation research need skills in each of the following three areas:

1. ***Knowledge of biological/disease processes, disablement, and rehabilitation.*** Understanding of the scientific and theoretical basis of the intervention under study (e.g., neural mechanisms of behavior) is needed to advance knowledge of rehabilitation. As described above, advanced courses and/or directed readings (e.g., neuroanatomy, learning theory) may be required. A wealth of educational resources is available to solidify Fellows' understanding of the pathophysiological and recovery processes including numerous CME courses offered through UMDNJ-NJMS and Kessler Foundation Research Center. Other valuable didactic opportunities include: grand rounds; numerous courses and lectures offered to residents, and directed readings. Measures of case severity, disease stage, case complexity, impairment, disability, and handicap need to be understood for the groups under study. Fellows with little prior experience with clinical rehabilitation will be asked to

observe or participate in relevant rehabilitative settings (e.g., team conferences, interviews with and service to disabled persons at home, etc.)

2. Knowledge of statistics, methodology, and research design. All Fellows must attain a basic competency in statistics and research design or add to their previous knowledge during the Fellowship. M.D./D.O. Fellows proposing a full one-to two-year Fellowship who have not had a course in either topic are required to complete a course in basic biostatistics and in research design. Fellows will be required to study and show proficiency in the following:

- **How to ask a relevant and testable experimental question (hypothesis)**
- Basic research design: the randomized true experiment and common pitfalls for investigators using this method;
- Systematic approach to demonstrating observations in single-subject and case series reports and appropriate statistical comparisons for these settings
- Strong quasi-experimental designs (e.g., time series) versus weaker ones (e.g., case control, matching, covariance, correlational designs);
- Descriptive and correlational studies (e.g., cross-sectional) and inference of causality; Cohort and retrospective study design; interpretation of descriptive statistical results;
- Prognosis and prediction (e.g., longitudinal) principles and studies;
- Specification of research subjects and sampling techniques;
- Principles and methods of functional assessment and measurement, including reliability, precision, and validity of measurement; methods of assessment of impairment, disability, handicap, and the qualities of everyday life;
- Evaluation of relevant diagnostic tests;
- Sample size and power requirements;
- Structure for a planned analysis in a research proposal, including *a priori* vs. *post hoc* investigations, control procedures and variables;
- Project management; use of consultants (e.g., statistical)
- Organizing a pilot study - pretest, quality control;
- Basic descriptive and inferential statistical principles; Use of SPSS, Stata, or other statistical programs; Correlation coefficients, non-parametric statistics, basic ANOVA and ANCOVA;
- Organizing data collection for accuracy and efficient data entry and analysis; Data cleaning;
- Use and secondary analyses of databases.

Fellows without a deficiency in basic methodology should advance their skills by mastery of statistical or methodological tools that will give them an edge in research quality in their research area(s). Optional statistical and methodological skills, (depending upon the rehabilitation research topics) might include:

- Advanced research design (e.g., randomized block designs, multiple interrupted time series, regression discontinuity);
- Intermediate statistical methods (e.g., multiple regression, techniques for the analysis of partial variance, Classification and Regression Trees);
- Advanced statistical techniques (e.g., structural equation modeling, LISREL, Poisson and Cox regression, Class);
- Actual secondary analysis of disability-related health care databases, e.g., UDS, National Medical Care Expenditure Survey, MedPars);
- Meta-analysis techniques;
- Rasch analysis versus traditional factor analysis and test reliability;
- And many other possibilities.

- 3. Other specialized research tools and subjects.** Research involves a number of refined skills. Proficiency in the following research skills must be demonstrated or acquired during the Fellowship:
- Defining a research question likely to yield productive, testable hypotheses;
 - Library reference search and computer searches (e.g., Medline);
 - Internet access;
 - Critical review of the scientific literature in a selected area;
 - Technical skills in equipment and procedures, as needed;
 - Scientific writing;
 - Grant preparation - basic NIH formats and processes;
 - Oral presentation;
 - Computer use - word processing, database, statistics;
 - Questionnaire and interview design, choice, and interpretation;
 - Choosing, encouraging, and working with collaborators.

As required, deficiencies in the above skills can be remedied by attending the summer research course for residents at UMDNJ, by directed independent study, or by formal coursework at UMDNJ or another institution.

Didactic Opportunities: In addition to working with the primary mentor, exposure to relevant rehabilitation and or neuropsychology/neuroscience issues will be ensured by the didactic opportunities offered by the various participating departments at each site (e.g., Department of PM&R), including monthly grand rounds, Physiatry residents' weekly internal rounds, and weekly Brain Injury rounds at Kessler's Brain Injury Center. Opportunities to observe direct clinical management of patients will be designated through the Fellowship Committee on an individual basis. Numerous programs are available for advanced training in the clinical neurosciences between the Psychology Department and Center for Molecular and Behavioral Neurosciences (CMBN) at Rutgers University, and the Departments of Neurosciences and Radiology at UMDNJ. These include: 1) weekly clinical rounds; 2) Rutgers Speaker Series; 3) Neuropsychology speaker series at Kessler Foundation Research Center; 4) SCI grand rounds and 5) Kessler Foundation Research Center fellowship didactics.

Current areas of research

The table below lists current areas of research by readily available mentors. Research Fellows are expected to develop their own research interests, and their research projects may combine or cut across listed research areas. Actual areas of research using Faculty at the UMDNJ and affiliated organizations go far beyond the listed areas.

Current Areas of Research

Brain Injury

Behavioral management
Cognitive rehabilitation
Driving evaluation
Effectiveness of post-acute cognitive remediation programs
Efficacy of chemodenervation treatment for post traumatic spasticity
Fatigue
Learning and memory
Neuroimaging
Neuropharmacological management of post traumatic fatigue and cognitive deficits
Role of memory and other neurobehavioral factors
Spatial and attentional disorders
Static and dynamic balance deficits

Biomechanics

Intersegmental coordination of upper and lower limbs
Kinematic and kinetic analysis
Static and dynamic gait stability
Static and dynamic posturography

Exercise Physiology

Blood lipids glucose and insulin sensitivity
Body composition
Energy consumption
Functional electrical stimulation
Skeletal muscle cross sectional area

Engineering

Dynamic EMG algorithms of periodic motion

Functional Rehabilitation

Body weight supported walking
Cognitive demands of driving
Cognitive retraining
Evaluation of ADL's
Wheelchair propulsion biomechanics

Multiple Sclerosis

Cognitive rehabilitation
Driving
Functional assessment
Information processing speed
Neuroimaging
New learning and memory
Working memory

Neuroscience

Immunology of Multiple Sclerosis
Molecular neurobiology
Neuroanatomy
Neurodegenerative Parkinson and Alzheimer disease
Neuroendocrinology
Neurotransmitters
Reorganization of motor cortex
Reorganization of central pattern generators
Brain-behavior correlations in neurological symptoms

Orthopedics

Shoulder pain and pathology
Total hip arthroplasty
Viscoelastic supplementation

Outcomes Research

Functional outcome studies
Health services research
Quality of life
Vocational mentoring and role restoration

Psychology / Neuropsychology

Aphasia, normal speech and language
Cognitive rehabilitation
Information processing speed
Learning and memory
Limb apraxia, normal limb praxis
Neuroimaging
Relationship between neuropsychological assessment and functional status
Spatial cognition and spatial neglect
Working memory

Psychosocial Factors

Home treatment of behavioral problems

Spinal Cord Injury

Alternative pain therapies
Cardiovascular function and disease
Chemodenervation treatment for spasticity
Diet and exercise
Driving retraining
Drug and hormone therapies
Functional use of the Wheelchair
Heart rate variability and autonomic nervous system dysfunction
Osteoporosis
Quality of Life
Restaurant accessibility

Secondary disability treatment
Shoulder pain and pathology
Supported walking
Urological function
Wheelchair propulsion biomechanics

Stroke

Amnesia and functional disability related to memory disorder
Aphasia and functional communication
Body weight supported walking
Chemodenervation treatment for spasticity
Disorders of attention
Disorders of emotional perception, representation and behavior
Electrical stimulation
Exercise fitness training
Gait economy
Limb apraxia and other motor-action disorders
Neuropsychological factors
Spatial cognition and spatial neglect
Virtual reality and motor recovery of hemiparesis

Technology

Telerehabilitation
Virtual Reality

The Mentoring Team

Medical rehabilitation research is multidisciplinary. The most productive rehabilitation research is likely to require the complementary skills of several disciplines and professionals. To be specific, we feel that the most productive rehabilitation research involves the connection of three domains: 1) applied rehabilitation content; 2) a scientific, biomedical or psychosocial discipline and/or specialization area(s); and 3) state-of-the-art laboratory techniques, statistical analysis, research design skills, and other scientific tools.

The mentoring team. The training program is based on a structured plan for a mentoring team. Each mentoring team will be comprised of these structural elements:

- 1) A Primary Rehabilitation Research Mentor, who works closely with the fellow throughout the various stages of training, including development of the fellowship training plan, overseeing research activities and training activities and ensuring the application of the proposed research and training plan to rehabilitation and grounding in biological knowledge. This mentor will provide guidance in the particular rehabilitative group (e.g., TBI, stroke) and/or scientific discipline (e.g., neurophysiology, pharmacology, neuropsychology). The primary mentor will ensure the progress of the trainee by weekly meetings, direct supervision of manuscript and grant writing, and fostering collaborative relationships between the trainee and other researchers and clinicians.
- 2) Assistive Mentor(s), who provide directed study or experience. On some teams, assistive mentors provide only a little time, ensuring quality research and providing strategic guidance, with the Primary Mentor dominating the research program. This is the classic primary mentoring structure. Even in these situations, our experience has been that the presence of other Mentors with formal input into the Research Training Plan is highly valuable. In other cases, Fellows have organized a broader team of mentors in which power is more diffuse, with multiple influential mentors. The experience of organizing their research team has been a worthwhile learning experience for our Fellows.

Each Fellow has a single *Primary Mentor*, who is responsible for providing the Fellow with adequate opportunities to learn and to succeed in research, for monitoring Fellow progress, for progress reports (delegated to the Fellow in practice), and for spending adequate time with the Fellow. The Primary Mentor plays a primary role in the direction of the Fellow's Research Plan and progress.

An acceptable Mentoring Team must be constructed so that at least one Primary Mentor and one assistive mentor are chosen. Complete descriptions of the research interests of the faculty can be found in the enclosure "Program Faculty".

Breadth requirements. Cross-training will be encouraged to ensure breadth as well as depth of training. For instance, a Ph.D. may spend most of his/her time with another Ph.D. neuropsychologist or physiologist but would need to spend time with a clinical rehabilitation researcher (e.g., physiatrist) to ensure relevance to clinical rehabilitation needs and to enhance the individual's knowledge of clinical rehabilitation. An M.D. is likely to need to work with a Ph.D. specialist to achieve excellence in a specialized area of research. Mentors will not be chosen entirely from the same discipline or area of research.

Primary Mentors

Anna M. Barrett, M.D.

Director, Stroke Rehabilitation Research

Anna M. Barrett, M.D., is the Director of Stroke Rehabilitation Research at the Kessler Foundation Research Center and is an Associate Professor in the Departments of Physical Medicine & Rehabilitation (PM&R), and Neurosciences at the University of Medicine and Dentistry of New Jersey-New Jersey Medical School (UMDNJ-NJMS). She has published research on spatial cognition, cognitive rehabilitation, cognitive communication and memory in neurological disorders for the last 22 years, and her ability was acknowledged at Penn State College of Medicine with the Samuel Hinkle Society Outstanding Junior Investigator award, for a basic or clinical junior faculty researcher, and nationally by Ohio State University's Harold Brenner Pepinsky Early Career Award in Neurobehavioral Science, honoring early career scholars in the fields of neurobehavior, cognitive neuroscience, neuropsychology, neurology, or related fields. She received the Norman Geschwind Prize for Behavioral Neurology Research, and the first International Neuropsychological Society Early Career Award. Since 1999, her lab had had continuous NIH funding, and other studies post-stroke spatial cognition in near and far space, the spatial neglect syndrome and its characterization and treatments, treatment of aphasia, and other post-stroke cognitive disorders including limb apraxia, emotional perceptual and processing disorders, disorders of internally-generated behaviors and memory. Dr. Barrett also has a strong interest in functional disability and its relationship to traditional neuropsychological definitions of cognitive disorder. Dr. Barrett served on two NIH review panels and reviewed for NSF and several foundations. She co-edited three special issues and supplements on the subject of post-stroke rehabilitation, and is a leader in the American Society of Neurorehabilitation and the Behavioral Neurology and Neural Repair and Rehabilitation Sections of the American Academy of Neurology.

Peter Barrance, Ph.D.

Interim Director, Rehabilitation Engineering Analysis Laboratory (REAL)

Peter Barrance, Ph.D., is the Director of the Rehabilitation Engineering Department at Kessler Foundation Research Center. REAL includes four Rehabilitation engineering investigators with support staff and equipment. Dr. Barrance's expertise is in the area of joint biomechanics and physiology, especially in the modeling and visualization of weight bearing joints using innovative imaging techniques. Several of his current research activities center on development and utilization of techniques for MRI imaging of the knee. The advent of vertically open MRI scanners has made imaging of the knee while a subject is weight bearing possible. The significance of this is that there is growing evidence that changes to load distribution across the cartilage surfaces are potent predictors of the development and progression of disease pathologies, such as osteoarthritis. Improved visualization of the weight bearing surfaces, combined with analytical modeling of joint contact conditions, allows detailed investigation of these processes as well as the effects of interventions. Dr. Barrance is currently the principal investigator on a federal grant to develop refined standing MRI imaging and modeling methods, with the goals of decreasing imaging time, increasing resolution, and increasing the precision of quantitative outcome measures. Dr. Barrance also has interests in biomaterials and biomechanics testing. He participates in diverse rehabilitation engineering projects, such as the development of innovative wheelchair seating devices

Nancy Chiaravalloti, Ph.D.

Director, Neuropsychology / Neuroscience

Nancy Chiaravalloti, Ph.D., is the Director of Neuroscience Research at Kessler Foundation Research Center, an Associate Professor in the Department of PM&R at UMDNJ-NJMS, and a licensed psychologist in the States of New Jersey and New York. Dr. Chiaravalloti conducts research in new learning and memory across various neurological populations. She has had significant grant successes over the years including an ongoing RO1 to conduct a clinical trial to examine specific behavioral techniques to improve learning and memory in persons with MS as well as a competitive supplement to allow for pre and post neuroimaging in that clinical trial. In addition, she is the PI on the site specific project for the NIDRR funded TBI model system, which examines a behavioral intervention for memory deficits following TBI. Her grant history also includes projects funded by the National MS Society and the National Stroke Association. In addition to her extensive grant funding, Dr. Chiaravalloti has authored over 40 academic publications and has made over 4 dozen presentations of her work at national and international conferences. Dr. Chiaravalloti has been very active in the mentoring of fellows (see Table 10). Several fellows have worked with her in the areas of neuropsychology, neuroscience, and cognitive rehabilitation and she has worked with several fellows in grant submittals. A second major area of research interest for Dr. Chiaravalloti is in functional neuroimaging (funded by the National MS Society) in an effort to identify the cerebral substrates underlying cognitive dysfunction and potentially to monitor cognitive rehabilitation effectiveness. She has worked with several fellows in this area of work as well. Dr. Chiaravalloti has published extensively with many of the fellows in our program. In addition, her line of research has been well received by the field and Dr. Chiaravalloti has been the recipient of several early career awards including the National Academy of Neuropsychology's Early Career Award for Contributions to Clinical Neuropsychology (2005) and the Rosenthal Early Career Award for significant contribution to research in Rehabilitation Psychology from the American Psychological Association, Division 22 (Rehabilitation Psychology; 2007). She is a member of the International Neuropsychological Society, the American Psychological Association, the National Academy of Neuropsychology, the American Congress of Rehabilitation Medicine, and the Cognitive Neuroscience Society.

John DeLuca, Ph.D.

Vice President, Research and Research Training

John DeLuca, Ph.D., is the Vice President for Research and Research Training at Kessler Foundation Research Center. Dr. DeLuca is a Professor in the Departments of PM&R and Neurosciences at UMDNJ-NJMS, and a licensed psychologist in the States of New Jersey and New York. He has been involved in neuropsychology and cognitive neuroscience research for almost 25 years. He is internationally known for his research on disorders of memory and information processing in a variety of clinical populations including: MS, aneurysmal subarachnoid hemorrhage, Chronic Fatigue Syndrome, and TBI. He has published over 300 articles and abstracts in these areas. Dr. DeLuca's most recent research ventures include the cerebral mapping of human cognitive processes using functional neuroimaging (i.e., fMRI, NIRS), as well as the development of research-based techniques to improve cognitive impairment. He has written over 25 book chapters, and is the editor of the book "Fatigue as a Window to the Brain". Dr. DeLuca has been very involved in training activities during his career. He has served as co-director for several advanced Research and Training programs sponsored by NIDRR, RSA, and NIH since 1990, and as Chairperson of the Research Fellowship Committee for the Department of PM&R at UMDNJ-NJMS. In addition, he advises Fellows on grantsmanship, research methodology and strategy, provides guidance in addressing research topics which are feasible and important, and provides overall supervision of Fellows to ensure quality training. His former students have been very successful in gaining academic and clinical research positions, and have continued to conduct clinical rehabilitation research. Dr. DeLuca is

an established leader in rehabilitation research and training. He has been honored with the Levitt Early Career Award from Division 40 of the American Psychological Association (APA), and also received the Early Career Award from the National Academy of Neuropsychology. He was also the recipient of the Distinguished Alumni Award from William Paterson University in 2002, and the Distinguished Researcher award from the New Jersey Psychological Association for 2005. Dr. DeLuca has served on numerous national and international committees and is on the Board of Trustees for the New Jersey Neuropsychological Society, serving as its President in 2002.

Trevor Dyson-Hudson, M.D.

Interim Director, SCI & Outcomes Research and Assessment (SCI)

Trevor Dyson-Hudson, M.D., is Interim Director of Spinal Cord Injury Research and Outcomes and Assessment Research at the Kessler Foundation Research Center (West Orange, NJ) and an Assistant Professor in the Department of Physical Medicine and Rehabilitation (PM&R) at the University of Medicine and Dentistry of New Jersey – New Jersey Medical School (UMDNJ-NJMS). He received his medical degree from the Albert Einstein College of Medicine in 1995. In 1992, while he was a third-year medical student, Dr. Dyson-Hudson sustained a spinal cord injury (SCI; C6/C7 tetraplegia, complete) while playing rugby football. Following a year of rehabilitation, he returned to medical school in 1993 and graduated in 1995. He completed a one-year transitional internship at the Albert Einstein College of Medicine in 1996 and completed a Rehabilitation Research Fellowship with the Department of PM&R at UMDNJ-NJMS and the Center for Complementary and Alternative Medicine for Stroke and Neurological Disorders at Kessler supported by a National Institutes of Health (NIH) Postdoctoral Fellowship supplement for individuals with disabilities in 2000. Dr. Dyson-Hudson conducts clinical SCI research and is principal investigator/co-investigator on a number of SCI grants. He is the Project Director of the Northern New Jersey SCI System (NNJSCIS), a National Institute on Disability and Rehabilitation Research funded SCI Model System of care. His research interests include restoration of function and mobility in persons with SCI and the prevention and treatment of common secondary medical complications affecting this population, including pain, musculoskeletal overuse injuries, cardiovascular disease, and respiratory complications. He is the Chair of the NNJSCIS SCI Community Advisory Board and serves in on the TBI Community Advisory Board for the Northern New Jersey Traumatic Brain Injury System. Dr. Dyson-Hudson is a licensed physician in New Jersey and New York. He is on the Professional Standards Board for the Rehabilitation Engineering Society of North America (RESNA) and the Spinal Cord Leaders Council and is a member of the American Paraplegia Society (APS) and the American Spinal Injury Association (ASIA), as well as SCI-consumer organizations, the National SCI Association (NSCIA) and the United Spinal Association (USA).

Gail Forrest, Ph.D.

Interim Director, Human Performance and Movement Analysis Laboratory (HPMAL)

Gail Forrest, Ph.D., is the interim director of the Human Performance and Movement Analysis Laboratory at Kessler Foundation Research Center and Assistant Professor of PM&R at UMDNJ-NJMS. Dr. Forrest has an academic background concentrating in mathematics, and biomechanics. As a postdoctoral fellow at Kessler Foundation Research Center in 2002, Dr Forrest was awarded grant funding by the New Jersey Commission on Spinal Cord Research to investigate “locomotor training (LT) using body weight support with manual assistance for individuals after Incomplete SCI. Dr. Forrest has received further grant funding to investigate the affect of LT in combination with functional electrical stimulation on the improvement of walking/standing and the improvement of secondary complications such muscle atrophy, muscle volume, bone loss, and neural plasticity for individuals after a spinal cord injury. She has published in the area of bone, and muscle loss after SCI and is now investigating bone

geometry using geometry of bone and bone mineral density variables. Furthermore, Dr. Forrest (as co-principal investigator) has recently received an award from the Christopher Reeves Foundation (CRF) and Center for Disease Control for a project entitled "CRF- NeuroRecovery Network (NRN)" to translate the locomotor training from the research domain into outpatient clinic within Kessler Institute of Rehabilitation (KIR) to offer LT as part of the outpatient program. The Kessler Foundation Research Center/KIR center is one of 7 centers that belong to the national CRF-NRN. This grant has allowed Dr. Forrest to further look at neuroplasticity and musculoskeletal changes for individuals after completion of locomotor training.

Jordan Grafman, Ph.D.

Director, Traumatic Brain Injury Research (TBI)

Jordan Grafman, Ph.D., is the Director of the Traumatic Brain Injury Laboratory. He received his B.A. degree from Sonoma State University in California and his Ph.D. from the University of Wisconsin-Madison in 1981. Immediately following his graduation, Dr. Grafman became the Neuropsychology Chief on the Vietnam Head Injury Study, a multidisciplinary study conducted at Walter Reed Army Medical Center in Washington, D.C. In 1986, he joined the National Institute of Neurological Disorders and Stroke (NINDS) as a Senior Staff Fellow in the Clinical Neuropsychology Section. In 1989, Dr. Grafman became Chief of the Cognitive Neuroscience Section at the NINDS. In January 2011 Dr. Grafman joined the Kessler Foundation Research Center as Director of the Traumatic Brain Injury Laboratory. He is an elected fellow of the American Psychological Association and has received the Defense Meritorious Service Award, National Institutes of Health Award of Merit, and the NIH Director's Award. He is co-editor of the journal CORTEX as well as the Handbook of Neuropsychology. He has over 300 publications in peer-reviewed journals and is internationally recognized for his work on the human frontal lobes and recovery of function after brain damage. Dr. Grafman's Laboratory is conducting studies attempting to identify the nature of representational knowledge stored in the human prefrontal cortex and the types of cognitive neuroplasticity that occur during learning and recovery from brain damage. His studies include patient participation as well as functional neuroimaging.

Assistive Mentors

Kessler Foundation Research Center

Jean Lengenfelder, Ph.D. - *Clinical Research Scientist*

Kessler Institute for Rehabilitation

Steven C. Kirshblum, M.D. - *Director, SCI Services*

Todd A. Linsenmeyer, M.D. - *Director of Urology*

Daniel Fechtner - *Director of Stroke Services*

Uri Adler, M.D. - *Staff Stroke Psychiatrist, Saddle Brook Facility*

NJIT

Rick Foulds, Ph.D. - *Associate Professor, Biomedical Engineering*

Stan Riesmann, Ph.D. - *Professor of Electrical Engineering and Biomedical Engineering*

Sergi Adamovich, Ph.D. - *Associate Professor, Biomedical Engineering*

Tara Alvarez, Ph.D. - *Assistant Professor, Biomedical Engineering*

VANJHCS

Frank Padberg, Jr., M.D. - *Professor and Chief of Vascular Surgery*

Len Pogach, M.D.

Catherine Myers, Ph.D.

University of Medicine and Dentistry of New Jersey

Karen Kepler, Ph.D., D.O. - *Director, Acute Spinal Cord Injury Rehabilitation*

Rutgers University - Newark

Mark Gluck, Ph.D. - *Associate Professor, Psychology*

Rutgers University - New Brunswick

Noshir Langrana, Ph.D. - *Professor of Biomedical Engineering and Mechanical and
Aerospace Engineering*

Dimitris Metaxas, Ph.D. - *Professor of Biomedical Engineering and Computer Science*

William Craelius, Ph.D. - *Professor of Biomedical Engineering*

Clinical, Laboratory, and Research Experience

Fellows will spend most of their time in conducting rehabilitation research under the direction of their mentors, selected for their ability to further the research abilities and publications of the Fellow. Each Fellow will be expected to publish his or her research in a peer-reviewed journal, and this will be an outstanding priority.

Clinical experience. One of the outstanding assets of this training program is the size and variety of clinical populations and rehabilitative treatment programs available. Research Fellows will have easy access to resources of the Departments of Physical Medicine and Rehabilitation, Neurosciences, and Psychiatry, to all four facilities of Kessler Institute for Rehabilitation, to the Veterans Administration New Jersey Health Care System at East Orange (VANJHCS), and Children's Specialized Hospital, all of which are affiliated with the Department of PM&R.

Clinical activities of the residency program (daily teaching rounds, weekly and monthly clinical rounds, clinical conferences, and lectures) at all seven facilities associated with the PM&R Department will be readily accessible to all Research Fellows. The availability of defined impairment groups at multiple facilities makes possible a much greater number of subjects than would be possible at any one facility. The combination of research experience and clinical population of our training program will make for fruitful collaboration.

Ph.D. researchers with inadequate clinical experience will be encouraged to participate in daily teaching rounds, clinical rounds, team conferences, and lectures. Mentors will encourage them to test their ideas in discussions with clinical professionals. The aim is to produce Ph.D. researchers who understand clinical realities and priorities and select research topics of clinical relevance.

Laboratory. Research experience is available at laboratories at UMDNJ, Kessler Foundation Research Center, the VANJHCS, and the Center for Molecular and Behavioral Neurosciences at Rutgers University, and at other affiliated organizations.

- In the Department of PM&R, there are active clinical research programs on the physiological, psychological, behavioral, and engineering problems in rehabilitation. In addition, there are a number of collaborative projects with other departments at UMDNJ. Research programs are currently underway to improve the functional abilities of persons with disabilities resulting from spinal cord injury, head injury, stroke, neuromuscular disease, pulmonary disease and amputations. Projects cover such areas as functional electrical stimulation, advanced electromyography, prosthetic design, sympathetic nervous system function in spinal cord injured patients, geriatrics, fatigue, treatment of depression, sexuality, and family training, among others.
- The research wing at Kessler Foundation Research Center includes a human performance laboratory for the measurement of motor control, coordination, and gait; a temperature and humidity controlled cardiovascular laboratory for measurement of peripheral blood flow and cardiovascular function; an engineering workshop; a quantitative electrodiagnostic suite; psychological testing rooms for neuropsychology and outcome studies; neuroimaging capabilities; a virtual reality setup; and ample office space.

- The VANJHCS is a fully equipped 1,000-bed medical center with both human and animal laboratories. The cardiac rehabilitation laboratory in the Rehabilitation Medicine Department includes a 3-foot-wide treadmill, making it accessible to disabled persons.
- Extensive engineering laboratories are available at New Jersey Institute of Technology.
- The Center for Molecular and Behavioral Neurosciences at Rutgers University, Newark, also has extensive laboratory facilities.

Experience in research administration. Fellows will develop (if they do not already have) skills and experience in research administration by preparation of research proposals, submission of these through the Research Committee and IRB of relevant facilities, and by the completion of their own research project(s), which frequently will be collaborative. Grantsmanship is likely to be chosen as a research tool by many Fellows. Such Fellows will collaborate with primary mentors in preparation of grant proposals.

Academic commitment. Our program also seeks to instill academic values and attitudes through socialization experiences with colleagues in the academic environment. This occurs in the context of a very supportive environment, with encouragement from the organizations, mentors and peers. The core didactic criteria provide the basic content knowledge and needed methodological skills. Work habits and involvement in simultaneous projects will be instilled. Mentors will provide the socialization and development of autonomy and personal commitment necessary to sustain research activity. The local mentors, outside lecturers, and attendance at professional conferences will all set the context for continuing collegial activities. Dr. DeLisa continues to direct his efforts on developing research throughout the PM&R Department, the residency program, and affiliated institutions.

Facilities at Kessler Foundation Research Center

Kessler Foundation Research Center, currently housed in the West Orange facility of the Kessler Institute for Rehabilitation (KIR), encompasses facilities supporting research in the variety of areas described in the previous section of this report. Modular office furnishings, with over 40 work stations, and various laboratories house staff in both administrative and research areas on the second and third floors of the facility.

The Human Performance and Movement Analysis Laboratory (HPMAL) encompasses 1,540 square feet, and is used primarily for 3D movement and gait analysis. It is equipped with the Vicon Workstation 3D Gait Analysis System from Oxford Metrics Ltd., two 4080H force plates from Bertec Corporation and a tethered MA-100 10-channel EMG system from Motion Lab Systems for use with surface and fine wire electrodes. Two eight channel stand alone stationary EMG systems using Gould amplifiers and LabVIEW data acquisition software enables flexibility for applications requiring variable electrodes and finer control of gain settings.

The Vicon system was the second of its kind in the United States to operate at a frame rate of 120 Hz, in addition to the traditional 60 Hz at which most systems operate. The motion-based tracking system is supplemented by simultaneous digital video capture through a JVC TK-C1380U digital video camera and Broadway Pro video card. A standard camcorder, VCR and television are part of the HPMAL resources for presentations. Further enhancing the ability of the HPMAL to accurately analyze gait is the F-Scan Pressure Assessment System from Tekscan, which allows for measurement of bipedal plantar pressure. Tekscan Timing Analysis Module software provides for interpretation of plantar pressure data.

The HPMAL is equipped with a D&L Development Wheelchair Racer, linked to a RacerMate CompuTrainer computerized training system that enables evaluation and monitoring of high-performance indoor wheelchair training. The lab has acquired four racing wheelchairs for further research in this area. During training sessions, heart rates are monitored and recorded using Polar® heart rate monitors.

Additional upper and lower body cardiovascular training can be performed on the SciFit Pro II. The SciFit Pro II is capable of both active and passive training of limbs during exercise. A Metabo Ergostat Universal upper body ergometer is located in the lab for graded exercise testing with a possible range of 12-450 watts of resistance. Anthropometric measurements are accomplished through use of Lange skinfold calipers, Continental Healthometer scale for height and weight, and General calipers for measurement of joint width.

The HPMAL is equipped to conduct metabolic energy cost analysis of all activities through two metabolic analysis systems. The K4b2 portable metabolic analyzer is a “backpack” unit allowing for “tether-free” activity under a wide range of conditions. The HPMAL is also equipped with a Q4000 cardiac telemetry unit. In addition, blood lactate levels can be monitored during exercise training and testing with the Accusport portable blood lactate analyzer. A Fischer Scientific -20 degree freezer is located in the lab for storing blood samples collected during exercise testing.

Additionally, the HPMAL is outfitted for conducting studies involving mental imagery and Constraint Induced Therapy. Upper extremity usage can be monitored through single axis accelerometers to track movement patterns over one week periods at the beginning and conclusion of study enrollment. Constraint of the non-affected limb is through Sammons-Preston slings and mitts.

Six computer workstations run Windows/NT 4.0 and two others run Windows 95. Five of these workstations have Pentium III processors; one has a Pentium II processor, two have Pentium processors. The workstations have data analysis and report generating capabilities that are independent of data collection. Additional data acquisition can be accomplished through LabVIEW 5.0 software on one of the workstations. Data processing and statistical analysis is accomplished through MatLab Ver. 5.3 and SPSS Ver. 10.0 software. Mathematical modeling algorithms are accomplished using Visual C++ software. Adobe PhotoShop is utilized for editing of digital images collected during testing procedures.

The Neuropsychology and Neuroscience Laboratory (NNL) conducts research and training in the study of human cognition and its rehabilitation in clinical populations using the research approaches of neuropsychology, functional brain imaging, and cognitive neuroscience. Current research examines neuropsychological deficits associated with a variety of clinical populations, including multiple sclerosis, traumatic brain injury, anterior communicating artery aneurysm, and stroke. Research examining the impact of cognitive impairment on functional status has been a strong focus of this lab.

The lab is equipped with 2 testing rooms that are used for patient interviews, neuropsychological testing, and feedback sessions. Specialized computer-based programs and protocols have been developed within the lab for testing attention, working memory, language processing, and for perceptual identification priming. Numerous standardized neuropsychological tests as well as a variety of books and journals relating to neuropsychology, neuroscience and neuroimaging are available within the lab.

The lab currently has 12 desktop workstations, 2 Mac PowerBooks, and a number of laptop computers equipped with numerous software packages, including statistical packages such as SPSS, reference management software (i.e., ProCite), and stimulus delivery software (i.e., E-Prime) to assist in conducting the research both in the West Orange facility and off site. All investigators including graduate students, post-docs, and clinical scientists have access to a laptop.

Functional Imaging Resources in the Neuropsychology and Neuroscience Laboratory at Kessler Foundation Research Center

Functional neuroimaging is an important component in much of the neuropsychological research conducted within the NNL. Because of this there are multiple facilities where this work is conducted. The NNL maintains an optical imaging system (NIRx-DYNOT) in-house which allows for on-site brain imaging research to be conducted in conjunction with traditional neurocognitive assessment. This system is truly state-of-the-art (there are only 2 brain imaging systems like it in the country) and provides investigators with an expandable, portable, modular system design for the assessment of a variety of motor, sensory, and cognitive functions. It has a large dynamic range ($1:10^9$) and multiwavelength DC illumination (up to 4 laser diode sources). The DYNOT system provides the opportunity to examine on-task brain functioning without many of the limitations inherent in MR-based research (e.g., subject confinement, limitation in paradigm development).

The NNL has a strong presence in the *Department of Radiology* at UMDNJ-New Jersey Medical School, where much of its imaging research is conducted. The Department of Radiology is a full-service diagnostic and therapeutic academic department, with 32 attending radiologists (26 full-time, 6 part-time) and 18 resident physicians-in-training. Dr. Wen-Ching Liu, who is in charge of this laboratory, has an office with 120 sq. ft in the same floor of the Hospital. The imaging modalities available in the Radiology Department include:

- Magnetic Resonance Imaging (MRI): There are two GE Horizon 1.5T MRIs on the Newark campus, one located in University Hospital and one in the Doctors' Office Center (DOC) building. In addition, there is a 3T MRI located in the Advance Imaging Center where more limited volume head scans are performed. Patient monitoring is accomplished via OmniTrak MRI Patient Monitoring System for monitoring of ECG, respiration, and non-invasive blood pressure.
- CT Scan: Two helical GE CT scanners are situated in University Hospital and one helical GE CT is located at the DOC. Two of these scanners are in the process of being upgraded to 16-slice units. There is a state of the art GE PET/CT scanner located in the Advanced Imaging Center.
- Interventional Radiology: There are three interventional suites within the Radiology Department at University Hospital, two of which are equipped for single-plane vascular angiography and one for bi-plane capabilities often needed in neurological radiology. These rooms are operational most of the time in order to handle the volume of inpatient, outpatient and emergency trauma cases that come through our ED.

- Ultrasonography: All visceral and small parts ultrasound is accomplished in radiology with equipment manufactured by GE and Acuson, two of the leaders in ultrasonography equipment. University Hospital also has a separate vascular lab for the performance of vascular Doppler studies.
- Radiography / Fluoroscopy: All exams considered integral components of diagnostic imaging are performed at both University Hospital and the DOC.
- Nuclear Medicine: Four separate cameras handle the imaging needs of this busy sub-department in the hospital radiology division. All standard bone, pulmonary and cardiac imaging are performed here.
- The Functional Imaging Laboratory, located in the Department of Radiology (room UH-110) is a 441 sq. ft. space with four Sun workstations connected to the MRI scanning area by a dedicated high-speed fiberoptic ETHERNET cable. The two Sun Ultra 10, one Ultra 60 and one Blade 2000 workstations, all with 21" monitors, serve as the main stream for high power computation. The various peripherals including Apex 4.6 GB MO drives, DAT drive, and three expandable high-capacity multi-pack hard disk storage devices also are connected and available in the laboratory. In addition, three Apple Macintosh computers (Power Mac G3 400 MHz), all with 21" monitors and multiple external drives; and one PC (166 MHz clone with 17" monitor) are also available for word processing and slice preparation. Several software packages are installed in the Sun workstations for functional data processing including Statistical Parametric Mapping from Wellcome department of Neuroscience (London) and AFNI (NIH). High-end computer language such as Interactive Data Language (IDL) and Matlab are also available for researcher to develop software for their own application.

In addition, Kessler Foundation Research Center maintains a new in-house fMRI laboratory. Within the NNL, very large imaging data sets are supported through the use of 2 powerful imaging laptop computers (each 3.0 GHz, 1 GB RAM), 2 desktop workstations (Niveus 2x 3.2 GHz processors, 4GB DDR RAM), and a server and network capable of receiving, transferring and housing all data (Relion 430 Server, Dual Intel Xeon Processors, 2 x 2.4 GHz, 4 x 1 GB RAM).

Outcomes and Assessment Lab

The Outcomes and Assessment Research Lab is led by Trevor Dyson-Hudson, M.D., Interim Vice President of Outcomes and Assessment Research. The lab is staffed by a research scientist (Amanda Botticello, Ph.D., MPH) and a part-time research assistant. The planned growth of the lab in the upcoming year includes the addition of a research scientists as well as ongoing grant-writing and dissemination efforts. The Outcomes and Assessment laboratory has extensive experience in developing and validating new measures of cognitive and neuropsychological functioning. The group also has experience developing new measures using Virtual Reality and is interested in utilizing new technological advances in science to improve measurement. Currently, the Outcomes and Assessment researchers are heavily involved in multisite collaborative projects to improve the measurement of Health-Related Quality of Life in diverse patient populations such as individuals with spinal cord injuries, traumatic brain injuries, wounded warriors, and Huntington's disease. This group also functions in a consulting capacity with other Kessler Foundation Research Center researchers by collaborating across labs in research related to medical rehabilitation outcomes and measurement. A number of statistical software packages including STATA, PARSCALE, SPSS, HLM, and Winsteps, reference management software Reference Manager, database management software Access, qualitative analysis software NVivo, and the stimulus delivery software E-Prime, are employed by these researchers to write grants, store data and conduct complex analyses for measurement development and data dissemination.

Dr. Dyson-Hudson and the other researchers in the Outcomes and Assessment Research Lab have received extensive funding from the National Institutes of Health (NIH; National Center on Medical Rehabilitation Research/NCMRR and National Institute on Neurological Disorders

and Stroke/NINDS), the National Institute on Disability and Rehabilitation Research (NIDRR), and the Department of Veteran's Affairs Rehabilitation Research and Development Program (RR & D). The support of these agencies has greatly contributed to the evolving focus of the lab on the improved measurement of health-related quality of life (HRQOL) – one of the most widely used patient outcomes following rehabilitation. These Kessler Foundation Research Center researchers are developing new outcome measurement tools that will be integrated with leading measurement initiatives funded by the NIH such as the Patient Reported Outcomes Measurement Information System (PROMIS), Quality of Life in Neurological Disorders (Neuro-QOL), and the Toolbox for the Behavioral and Neurological Functioning projects. These next generation initiatives will be used as the leading outcome measures in forthcoming federally funded clinical trials research and clinical practice. Item Response Theory (IRT) is the basis for development of these new outcome measures; many limitations of existing instruments are addressed through development of IRT-informed Computerized Adaptive Tests (CAT). The scales are built using a participatory action research approach to the development process steeped in grounded theory where individuals with a disability have had a voice in the development of condition specific targeted item banks to evaluate the symptoms, concerns, or other HRQOL issues that stem from the specific conditions. The NIH is seeking to provide researchers with a uniform, standardized outcome measure that can be used in NIH-funded research studies so that outcomes across conditions can be compared and contrasted.

The Kessler Foundation Research Center Outcomes and Assessment Laboratory are also funded to develop new measures of cognitive functioning and have been actively developing new measures of working memory and processing speed. The Outcomes and Assessment research laboratory is a primary development site for the NIH funded Toolbox for Neurological and Behavioral Functioning.

Spinal Cord Injury Lab (SCI)

The SCI Lab at Kessler Foundation Research Center is led by Trevor Dyson-Hudson, M.D., Interim Director of the SCI Research Laboratory and Steven Kirshblum, MD, the Director of the SCI Program at KIR. It is comprised of an Associate Director (TBA), a doctoral-level Research Scientist (Denise Fyffe, Ph.D.), full-time research coordinator, full-time research assistant, and full-time secretarial support. It conducts studies designed to prevent the loss of function, restore lost functions, eliminate medical complications, and improve quality of life in persons with SCI. At the center of this multidisciplinary laboratory is a grant from the National Institute on Disability and Rehabilitation Research (NIDRR) designating the spinal cord injury program as a “model system” of care and research, which provides funding at a level of approximately \$457,000 per annum for the current grant cycle. The Northern New Jersey Spinal Cord Injury System (NNJSCIS) is one of 14 such designated model spinal cord injury systems in the U. S. and is a cooperative effort of the Kessler Foundation, UMDNJ, and the Kessler Institute for Rehabilitation.

Current research in the lab focuses on measure development and improving health and functioning for individuals with SCI. The lab is currently leading two multi-site projects focused on developing new “patient reported” outcome scales that will be used as outcome variables to evaluate changes in functioning in clinical trials and clinical practice. The scales cover a wide variety of health domains (e.g., functional activities and limitations due to the disability, emotional functioning, social functioning, and medical health issues). The lab is also engaged in a clinical trials study to test a new intervention to improve respiratory functioning and help individuals prevent serious respiratory complications. The lab's research also includes improving community participation by eliminating environmental barriers and by utilizing virtual reality (VR) technology and assistive technology for mobility (e.g. wheelchairs).

Research in the SCI Lab has been funded by NIDRR, the NIH (National Institute on Child and Human Development/National Center on Medical Rehabilitation Research and the National Institute on Neurological Disorders and Stroke), the New Jersey Commission for SCI Research, and the Kessler Foundation. Collectively, the SCI Research Lab is one of the most active Spinal Cord Injury Research Labs in the country. Kessler Institute for Rehabilitation (KIR) is a major affiliate of Kessler Foundation Research Center, providing an interdisciplinary approach to

physical medicine and rehabilitation, and offers comprehensive inpatient and outpatient services for individuals who have experienced brain injury, spinal cord injury, stroke, amputation, neuromuscular disorders, and musculoskeletal or orthopedic conditions.

The SCI Lab has 12 desktop workstations and offices and 4 laptop computers with Windows XP operating systems, SPSS12.0, reference manager software, and other word processing and data analysis software. All investigators have access to a laptop. The SCI Lab has a Virtual Reality (VR) system comprised of three 24" flat panel monitors and a 5-speaker audio system combined with virtual reality software designed specifically for our lab as a state-of-the-art driving simulator. The NNJSCIS has access to a sophisticated eye-tracking system, head-mounted display units, and engineering and information technology support for research involving virtual reality technology. The SCI Lab also has an Apogee 800 Diagnostic Ultrasound System equipped with a Super VGA video recorder and a linear array 7.5 MHz probe for performing carotid artery ultrasounds. Lastly, a vast library of relevant SCI reference texts and neuropsychological assessment measures are owned by the lab.

The Rehabilitation Engineering Analysis Laboratory was initiated in 2002 and continues to grow through the vision and support of Kessler Foundation Research Center and the Kessler Foundation. The division now has a staff of six: the two investigators and four technical support staff. These investigators (Peter Barrance, Ph.D., Interim Director of Rehabilitation Engineering) contribute expertise in the rehabilitation engineering subspecialties of biomechanics, biomaterials, and bioinstrumentation (e.g., systems control and clinical neuropsychological). These have application in a variety of research activities.

The Rehabilitation Engineering Analysis Laboratory (REAL) has approximately 1800 square feet of space that provides three experiment rooms and research seating for twelve investigators and staff. The three experiment areas include the REAL Subject Testing room, the REAL Virtual Reality (VR) and Computer Modeling area, and the REAL Biomechanics and Bioinstrumentation area. The REAL Subject Testing area has been equipped with an exam and setup area, a six-camera VICON-460 motion analysis system, and EMG equipment for balance and motion studies for evaluation of the effects of TBI and stroke. These studies utilize a NeuroCom Balance Research Platform and two portable AMTI AccuGait Force plates.

The REAL VR and Computer Modeling area was developed to provide resources for subject testing using virtual reality environments simulating driving and office activities. This area is being expanded to include REAL Computer Modeling to provide additional computers and current software (Mathematical, MatLab, SIMM, EMG Analyzer, and LabView) for computational analyses, structures, and dynamic simulations.

The third area is the REAL Biomechanics and Bioinstrumentation area, which provides a focus for materials testing and instrumentation development include facilities for prototype fabrication and light machining. Testing to determine the properties of human tissues and man-made materials is conducted using the multi-axis materials testing system, the Planar Testing Apparatus. The Rehabilitation Engineering division complements other Kessler Foundation Research Center resources and collaborates closely with other divisions.

The Stroke Rehabilitation Research laboratory is staffed by a coordinator and technical staff. To maximize the potential for translational research relevant to real-life function, the laboratory is equipped with video apparatus to measure visual-action performance in both near and far space (beyond reaching distance). With a video camera-monitor setup, we can manipulate visual feedback so as to fractionate errors into perceptual and motor components. An additional video apparatus set up for tabletop tasks is also in use. The lab is equipped with rooms for patient interviews, behavioral and clinical evaluation testing, data analysis and coding, and feedback sessions. A set of standard neuropsychological tests, standard equipment for stimulus administration including 2 slide projectors and an LED projector, and four video cameras are available for recording patient interviews and examination, neuropsychological testing equipment and personal computers to support lab activities are available. Evaluation, recruitment and testing of subjects for stroke research takes place at all four Kessler hospital

facilities, at UMDNJ, and at other hospitals, academic and care centers in the nearby community.

General support for all research is provided by the *Biomedical Engineering and Computing* facility. Standard test equipment includes a Tectonics TDS 544A 4-channel digital color oscilloscope with enhanced memory, floppy disk and PC interface, and real-time spectrum analyzer options. A BK Precision analog oscilloscope is also available. Triple-output and dual-output bench power supplies, an analog waveform generator, and a digital Arbitrary Waveform generator support the development of custom electronic devices and instrument modifications. Complete solder station, wire-wrap, and prototyping systems are available for custom device development and testing.

Biomedical engineering provides specific support to researchers working in the areas of biological signal processing, neuromuscular function, and human interface/assistive technology. Electro-physiologic research is supported by a complete set of general-purpose bioelectric instruments which are interfaced by engineering staff according to project needs and goals. An 8-channel biopotential amplifier (Gould 6600 series) supports traditional research involving EKG, EMG, and EEG studies. For higher frequency signals, an 8-channel 10kHz system (Gould 3500 series) is available. All systems include patient isolation and interface to the Data Network for on-line storage and analysis. Motor evoked potential and EMG research is supported by a Cadwell MES-10 magnetic stimulator with 9 cm. round and butterfly coils. A Dantec Mag 2 magnetic stimulator with round coil and an 8-channel Dantec Keypoint EMG/evoked potential/EEG computer provide facilities for 16-channel fine wire kinematic EMG studies. All instruments are interfaced to computers for additional data acquisition and processing.

Traumatic Brain Injury Lab (TBI)

The focus of research in the TBI research lab is identifying the forms of knowledge represented in the prefrontal cortex and related brain structures; and studying functional neuroplasticity during learning and recovery of function after brain injury. The operating framework to study these processes and their disorders is based on cognitive science theory although we plan to combine this approach with state-of-the-art clinical neuroscience techniques such as structural and functional MRI, Direct Current Stimulation, and Single-Pulse & repetitive Transcranial Magnetic Stimulation. The TBI lab provides ample opportunity for the development of innovative, focused research and broad collaborative cognitive neuroscience experience. The Lab will be studying healthy normal volunteers and patients with traumatic brain injury primarily but also other patients with focal brain lesions. The training program is designed as a 2-3 year experience that includes a speaker series, journal article discussions, TBI lab presentations and discussions, tutorial training, and the teaching of skills necessary to conduct original cognitive and neuroimaging research in cognitive neuroscience & Cognitive Neurology. Both Ph.D.'s and M.D.'s are encouraged to apply.

Kessler Foundation

Kessler Foundation is a nonprofit, public charity dedicated to supporting rehabilitation research, education and community programs. The Foundation is a major funding source for Kessler Foundation Research Center and is currently providing \$5.5 million each year for its operation. The Foundation is also focusing a large portion of its grantmaking on programs related to increasing employability for people with disabilities, as well as supporting not-for-profit agencies throughout New Jersey that provide services for people with disabilities.

Kessler Foundation Research Center

Kessler Foundation Research Center is a non-profit medical rehabilitation research and education organization, a subsidiary of a public charity, Kessler Foundation, Inc. The primary purpose of this organization is to promote high quality rehabilitation research and development activities that will improve health, promote wellness and ultimately improve the quality of life for persons with physical disabilities. Kessler Foundation Research Center presently has a full-time

staff of 65 individuals, with an annual operating budget of over 6 million dollars. Kessler Foundation Research Center is located within the Kessler Institute for Rehabilitation - West Orange facility and contains laboratories and programs in Neuropsychology and Neuroscience; Stroke; Traumatic Brain Injury; Rehabilitation Outcomes; Spinal Cord Injury; Human Performance and Movement Analysis; and Rehabilitation Engineering. Kessler Foundation Research Center has an external Scientific Advisory Board, chaired by Marcus Fuhrer, Ph.D., Director Emeritus, and National Center for Medical Rehabilitation Research, National Institutes of Health, which provides an objective critique of all research activity conducted at Kessler Foundation Research Center on an annual basis. The education division of Kessler Foundation Research Center organizes and hosts the nation's largest PM&R review course. The dedication of Kessler Foundation Research Center scientists to rehabilitation research provides broad opportunities for developing and sharing expertise in rehabilitation engineering, statistical analysis, computer programming, database management, research dissemination, and Internet applications.

Facilities of Adjacent Rehabilitation Hospital Kessler Institute for Rehabilitation (KIR)

Kessler Institute has four inpatient facility locations. These include the: West Facility, a licensed 78-bed facility located in West Orange (Essex County); East Facility, a licensed 100-bed facility located in East Orange (Essex County); North Facility, a licensed 52-bed facility located in Saddle Brook (Bergen County); and Welkind Rehabilitation Hospital with 72 beds in Chester (Morris County), a sister corporation. With a licensed capacity of 300 beds and over 5,000 admissions per year, Kessler Institute is one of the largest rehabilitation facilities in the nation. Kessler Institute draws 90% of its patients from a 6-county region of 3 million people, located within 50 miles of one of the Kessler facilities. Kessler Institute (230 beds) and its affiliates (72 beds) comprise 92% of the 330 rehabilitation beds in this region. Each of its facilities offers a full range of medical and rehabilitation services, including physiatry, nursing, psychological counseling, social services, vocational counseling and rehabilitation therapies on special program emphasis and in general rehabilitation. Among its 33 specialized treatment programs are: the cancer pain management program, the industrial rehabilitation/work hardening program, the performing arts medicine program, the post polio rehabilitation & research services, the sexuality and fertility clinic, the sports medicine center and the ventilator-dependent quadriplegia program. The Center for Ventilator Management Alternatives and Pulmonary Rehabilitation, directed by Dr. John Bach, offers intensive breathing instruction using non-invasive respiratory techniques which eliminate the need for a tracheostomy. This is currently one of only two centers in the United States which permits patients with no respiratory muscle function to develop freedom from mechanical ventilators/phrenic pacemakers.

Kessler also provides *subacute rehabilitation* through the Kessler Care Center at Cedar Grove, a 196-bed skilled nursing facility. This facility provides comprehensive subacute rehabilitation services in addition to long-term nursing care. In addition, KIR maintains outpatient services at all its facilities and has 23 outpatient satellites located in the Bergen, Essex, Hudson, Hunterdon, Middlesex, Morris, Ocean, Passaic, Somerset and Union counties in New Jersey. By means of its satellites, KIR brings its expertise, experience and skilled service providers to people right in their communities. The outpatient satellites provide physical therapy for musculoskeletal disorders, work related injuries, neck, mid-back and low-back pain care to improve the quality of life for many individuals who previously had minimal access to such services. These centers also provide lectures, screenings, educational seminars and support groups in order for patients and family members to share their insight with one another.

The *Program Evaluation Program* is supported by four professionals in charge of Total Quality Management, Infection Control, Utilization Review and Program Evaluation. The program evaluation system, utilizing the Functional Independence Measure (FIM) for all inpatients, has been in place for almost 15 years. The program evaluation system and medical records provide a core data set available for research projects.

Collegial and Collaborative Activities

Research Fellows will have extensive opportunities to meet experienced rehabilitation and biomedical researchers in New Jersey and New York City. Collaboration with a prominent researcher in a specific area is not only encouraged but required as part of the individual Fellow's Research Training Plan. The process of structuring a mentoring team will cause Fellows to make personal contacts with researchers throughout the Northeast U.S.

University of Medicine and Dentistry of New Jersey - New Jersey Medical School

UMDNJ-NJMS is approved by the Accreditation Council for Graduate Medical Education and offers a broad array of clinical and academic training services. The University Hospital has 518 beds apportioned among 11 clinical departments. In addition to the usual medical services, the hospital offers a wide variety of specialty services.

The Department of Physical Medicine and Rehabilitation at UMDNJ-New Jersey Medical School maintains close ties to the Kessler Foundation Research Center, the Kessler Institute for Rehabilitation, the Department of Veterans Affairs New Jersey Health Care System, the Atlantic Healthcare System and Children's Specialized Hospital. Under the supervision of the Department's clinical faculty based at these locations, PM&R residents, medical students and clinical fellows rotate through these affiliated sites in order to gain clinical experience. Much of the Department's research and academic work is also conducted at these facilities.

The chair of the PM&R Department, Dr. Joel A. DeLisa, also serves as President and CEO of Kessler Foundation Research Center. The Department includes seven full-time faculty members based in Newark at University Hospital, 47 full-time paid faculty based at major clinical affiliates, and approximately 50 voluntary faculty members who support the department's teaching programs on a part-time basis. Approximately 16 faculty members have completed research fellowship training, and 18 have completed clinical fellowship training. Total research funding to faculty at all sites from all sources is approximately \$6.7 million per year. Approximately 80 scientific research papers, 12 book chapters and two textbooks are published each year. In addition to extensive representation on major national organizations within the specialty of rehabilitation medicine, UMDNJ faculty also maintain a national presence on leading medical policy organizations such as the American Board of Medical Specialties, the Educational Commission for Foreign Medical Graduates, the Association of Academic Physiatrists, the Special Medical Advisory Group (VA), and the Association of American Medical Colleges. Since 1992, the Department has been a national leader in the use of the objective structured clinical examination within graduate medical education.

The Department's residency training program is recognized as being among the nation's best graduate medical education programs. The Department has received a full five-year accreditation (the longest term offered) from the Accreditation Council for Graduate Medical Education for both its general PM&R residency as well as for its fellowship in spinal cord injury medicine. More than 35 applications are received for each vacant residency slot. The curriculum includes mandatory training for each resident in the theory, design and conduct of medical research. For the past 15 consecutive years, 100% of the residents who have taken Part I (written) of the PM&R board examination during their year of graduation have passed on their first attempt. The program's residents consistently author articles in leading journals, receive appointments to national committees and offices, earn highly visible awards, and receive offers of employment from some of the nation's best-known fellowships and rehabilitation facilities. Over the past five years, 48% of the Department's graduating residents have entered fellowships, 18% have accepted positions in academic medicine, and 34% have pursued private practice opportunities.

In cooperation with its teaching affiliates and various sponsoring organizations, the Department conducts a "mandatory" clerkship for medical students at NJMS, and also offers medical fellowships in seven subspecialty areas. Additionally, the Department offers federally-funded postdoctoral research fellowships in the subspecialties of rehabilitation outcomes as well as neuropsychology and neuroscience. The number of postdoctoral fellows undergoing training ranges from approximately four to eight, depending on the quality of the applicant pool. The Department also sponsors an annual board review course that is the nation's largest and most popular course for graduates preparing for the board examination.

The Department of Radiology provides critical elements in supporting functional neuroimaging research. Primary among these resources is access to two 1.5 Tesla GE Signa MRI scanners equipped with Echo-planar imaging capability. A PET scanner has also recently been added to the Department. Additional resources include computing resources, lab facilities and administrative support.

The Department of Neuroscience conducts basic and clinical research on neurological disorders, such as multiple sclerosis, neuronal and retinal regeneration, Parkinson's disease, peripheral neuropathy, obesity, violence and aggression, learning disabilities resulting from membrane anomalies, stroke, and chronic fatigue syndrome. Because of the eclectic nature of the department, some research projects are directed towards revealing the basic mechanisms of disease, while other projects focus on improving clinical therapies.

The School of Allied Health. An array of speech/language pathology services, occupational therapy services, and physical therapy services are offered in the PM&R department and the Stanley S. Bergen Building, which houses the School of Allied Health Professions. Over and above the usual therapies, specialty clinics (e.g., hand, plastics) have been developed. The division of Physical Therapy provides services to both inpatients and outpatients in the following specialty areas: medical/surgical, orthopaedics, pain management, pediatrics and neurology.

Collaborative Facilities at the Veterans Administration New Jersey Health Care System

Kessler Foundation Research Center researchers conduct both human and animal studies in collaboration with other researchers at Veterans Administration, NJ Health Care System (VANJHCS). There is a human performance laboratory located in the Rehabilitation Medicine Service, including a wheelchair accessible treadmill, Quinton metabolic analyzer and stress ECG monitor, Peak Performance Analysis two-camera video gait analysis system, and Dantec Counterpoint 4-channel EMG.

New Jersey Institute of Technology

New Jersey Institute of Technology (NJIT) is a public research university with a specific focus on engineering, science, and technology. It is comprised of the Newark College of Engineering, the College of Science and Liberal Arts, the School of Computing Science, the School of Management, and the School of Architecture, and is New Jersey's technological university. NJIT was established in the late 1800's as part of the educational movement that saw the founding of RPI, WPI, Cooper Union, Stevens Institute of Technology, MIT and Georgia Tech. With 8000 students (5000 undergraduate and 3000 graduate), NJIT has the largest enrollment in engineering and computing among New Jersey universities. Over the past two decades, NJIT has successfully balanced the transition from a local engineering college to a national research university. It has a dynamic research program with annual sponsored research exceeding \$40 million. At the same time, however, it retains the focus on high quality education for which it has been well known. Students are attracted to NJIT because of its commitment to learning. NJIT graduates fill nearly 25% of all engineering positions in the State of New Jersey.

The NJIT campus is quite compact, comprising only 45 acres overlooking downtown Newark. All of its buildings are accessible to persons with disabilities, and the flat, small campus is ideal for persons with mobility impairments. NJIT's concern with accessibility predates Federal requirements. An active group of consumers, led by Frieda Zames (now professor emeritus) worked closely with the administration beginning in the 1960s to see that all new and renovated campus buildings were accessible.

NJIT's research facilities provide strong support for an Advanced Research Training grant. Kessler Foundation Research Center Fellows will find the NJIT faculty to be supportive of their work, and will have access to facilities needed in their work. NJIT is a technical university and its library and laboratories provide a very appropriate complement to those at Kessler Foundation Research Center. NJIT maintains a full research machine shop, microelectronics fabrication facility and academic computing (including access to supercomputing). The following four Biomedical Engineering research facilities are located in adjoining space in the Department's new building and occupy a total of approximately 2500 sq.-ft.

The Neuromuscular Engineering Laboratory was originally established with NIDRR funds at the University of Delaware and moved to NJIT in 1999. It includes facilities for the study of the kinematics of upper extremity movements. Current projects include studies of bimanual movement control, non-linear control of biomimetic muscles, measurement of

spasticity, vestibular contributions to spasticity, the role of spasticity in dysarthric speech, rehabilitation robotics and the recognition and animation of sign language. Its equipment includes a pair of Immersion Cybergloves (19 joint sensors), three Ascension Flock of Birds systems capable of measuring human movement (position and orientation) using electromagnetic signals in a 3 ft. radius, an ISCAN point of regard system capable of tracking eye movement (single eye), two SensAble Phantom force reflecting robots capable of producing 2 N force reflection to the fingers, an FCS Haptic Master robot capable of providing 20 N force reflection to the arm in four degrees of freedom, a 16 channel Grass EMG amplifier, a five camera large baseline stereo camera system, stereographic glasses and an electroglottograph for measuring glottal impedance.

The Motor Control and Rehabilitation Laboratory is NJIT's newest laboratory devoted to studies of motor rehabilitation and coordinated reaching. It is presently studying the use of video game and virtual reality technology among stroke survivors and is engaged in work on motor control of Parkinson's patients. Major new work on enhancing neural plasticity in persons with neural impairment is being developed with the Neuromuscular Engineering Laboratory and shares the FCS Haptic Master. Equipment in this laboratory includes an Optotrack motion analysis system, two stereo camera systems, a P5 sensed glove and an Immersion Cybergrasp, which provides haptic sensation to the thumb and four fingers. The Cybergrasp and Haptic Master are being combined into a hybrid system capable of providing full haptic rendering for the hand and arm. No such system exists in the U.S. at this time.

The Human Performance Laboratory is currently dedicated to studies of a new ballistic approach to human movement; this facility includes a 2-camera Qualysis motion analysis system that provides 3-D motion capture at 1000 Hz. Also included are two ATMI force plates.

The Neural and Vision Engineering Laboratory is engaged in the study of neuromotor activity involved in vision. It is supported by a binocular eye movement system. This laboratory collaborates extensively with the fMRI facility at the University of Medicine and Dentistry of New Jersey. The 3T magnet of the UMDNJ system makes it ideal for detailed research studies. An MRI capable eye tracking system has been ordered to support this joint work. Additional research is underway with the New York University School of Optometry and studies rehabilitation methods for ocular disorders.

Rutgers, The State University of New Jersey

With over 47,000 students on campuses in Newark, New Brunswick, and Camden, Rutgers is one of the major state university systems in the nation. The major units of Rutgers involved in this training grant are the Psychology Department and Center for Molecular and Behavioral Neurosciences (CMBN) at Rutgers University.

The Center for Molecular and Behavioral Neuroscience is equipped with high-tech microcomputers and relevant software designed for the study of the functional properties of the central motor system of the brain by means of 3-D kinematic analysis of movements. The laboratory has a Silicon Graphics IRIS 4D80GT and a Silicon Graphics Indigo 2 Superworkstation; state-of-the-art computer graphics display devices. These computers are special purpose computing machines for the creation, manipulation, and modification of complex 2-D and 3-D data structures. They allow dynamic interactive graphics, and display three-dimensional images with appropriate depth perspective and parallax on a high resolution cathode-ray tube. Function switches, control dials, data tablet and keyboard allow the operator to interact with the graphics processor. The 2-D and 3-D data structures resident in memory can be rotated, translated, scaled, clipped, and viewport mapped. Hence, complete data structures can be manipulated, and movements can be generated and displayed in real time. The laboratory is also equipped with Macintosh and IBM-based microcomputers. In addition, the Center for Neuroscience makes available an IBM PowerStation RS-6000/540 with three-dimensional rendering hardware, Macintosh computers for word processing and communication, Apple LaserWriter printer, slide printer, MicroVax II, access to NSFnet, and video recording and editing facilities.

The University Heights Center for Advanced Imaging contains a new high-powered (3-Tesla) functional magnetic resonance imaging (fMRI) scanner that provides detailed pictures of specific areas of brain activity that is enabling UMDNJ and Rutgers University-Newark

researchers to significantly advance neurological research, and better understand and develop potential treatments for brain injury and for devastating neurological diseases such as MS, Alzheimer's, and autism. The fMRI scanner is the centerpiece of the University Heights Center for Advanced Imaging. One of only a handful of such scanners being used nationwide, this fMRI scanner is housed at the UMDNJ's campus in Newark, and is jointly owned by Rutgers-Newark and UMDNJ.

The Bernard W. Gimbel Multiple Sclerosis Comprehensive Care Center at Holy Name Hospital

The Bernard W. Gimbel Comprehensive Care Center at Holy Name Hospital is a non-profit organization dedicated to serving people with MS and their families. The center's primary goal is to help people with MS and their families adjust to the disease and maximize the quality of their lives. The Gimbel Center achieves this goal by practicing a multi-dimensional team approach to clinical care which has proven to be the most effective and efficient way of treating persons with MS. This approach utilizes the coordinated efforts of health professionals from various disciplines, all trained to treat MS. These professionals provide neurologic and nursing care, individual and family counseling, physical therapy, occupational and speech therapy, social services, and individual and family education. June Halper, MSCN, ANP, FAAN, Executive Director and Chief Executive Officer of the Gimbel MS Center, and Mary Ann Picone, M.D., Medical Director of the Gimbel MS Center and a board certified neurologist with expertise in MS, are major research collaborators in much of the MS research conducted at Kessler Foundation Research Center.

I. APPLICATION PROCESS

The initial application involves submitting a cover letter detailing your research and clinical interests, background, and training, as well as copies of your CV, graduate transcript, and representative publications or manuscripts. Following review of the completed application, appropriate candidates will be contacted and invited for a formal interview.

Applicants

- Ph.D., M.D. - Doctoral degree should be in a field relevant to rehabilitation. Ph.D. candidates planning dissertation research on topics relevant to rehabilitation are also encouraged to apply.
- Non-immigrants are eligible to apply provided they can be lawfully employed in the U.S.
- Excellent academic record.
- Research experience: Ph.D. candidates should be proficient in basic research skills. Strong candidates will have either publications or publishable theses. M.D. candidates should have experience with research at least on the basis of an initial project.
- An expressed interest in pursuing a career in rehabilitation, particularly an academic or research career.

Application Instructions

In order to apply, please submit the following materials:

1. cover letter detailing research and clinical interests, background, and training
2. CV or resume
3. copy of graduate transcripts for current students and recent graduates
4. copies of publications or manuscripts that illustrate your research work
5. three letters of recommendation

Please send letters of inquiry and application materials to:

Neuropsychology/Neuroscience Fellowship

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Outcomes Research Fellowship

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Human Performance and Movement Analysis Fellowship

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If at any time during this application process, you have any questions or need further information please do not hesitate to call or e-mail Dr. John DeLuca, Vice President of Research and Training. Visit us <http://www.kesslerfoundation.org>