

**NEW JERSEY COMMISSION ON
SPINAL CORD RESEARCH**



2013 ANNUAL REPORT

JANUARY 30, 2014



January 30, 2014

The Honorable Chris Christie, Governor
Office of the Governor
State House – P.O. Box 001
Trenton, New Jersey 08625

Dear Governor Christie:

On behalf of the New Jersey Commission on Spinal Cord Research (NJCSCR), its members, staff and the spinal cord injured citizens of New Jersey; it is my privilege to present the Annual Report for Fiscal Year 2013, pursuant to N.J.S.A. 52:9E-4(f).

In 2013, the NJCSCR awarded nearly \$3 million, funding four Individual Research Grants totaling \$2,363,696, two Exploratory Research Grants totaling \$400,000, one Spinal Cord Injury Techniques Training Travel Grant totaling \$950, and two Fellowships totaling \$200,000. These projects were carefully selected by a panel of independent scientific experts from 36 applications submitted by researchers at New Jersey academic institutions, and approved by vote of the NJCSCR.

NJCSCR grants often produce the basic research findings necessary to compete successfully for larger NIH and other awards, and they help attract talented scientists and students to this exciting and promising field. Each of the funded projects has the potential to contribute significantly to the development of treatments and cures for the paralysis and complications that accompany spinal cord injury.

We wish to thank you, the Department of Health, and the State of New Jersey for continued support of spinal cord injury research.

Respectfully,

A handwritten signature in black ink that reads "Susan Howley".

Susan P. Howley
Chairperson



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2013 COMMISSION MEMBERS

Susan P. Howley, Chairperson

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John D. Del Colle

James McCormack

Michael J. Rhode

Loran C. Vocaturo, Ed.D.

ACKNOWLEDGEMENTS

The NJCSCR would like to express its sincere appreciation to all present and past Commission members, and to the New Jersey Department of Health for their expertise, time, and effort.

The NJCSCR also wishes to thank the Center for Health Statistics, Department of Health for the spinal cord injury surveillance statistics, and Commission staff members Christine Traynor and Mary Ray for their support.

This report is being submitted in fulfillment of the legislative mandate in the *N.J.S.A. 52:9E-4(f)*. The report describes the implementation of the Spinal Cord Research Act and evaluates the benefit of the Act as evidenced in this report of grant awards for State Fiscal Year 2012.

ADMINISTRATIVE STAFF

Christine Traynor, Administrator

Mary Ray, Fiscal Manager

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EXECUTIVE SUMMARY

The New Jersey Commission on Spinal Cord Research (NJCSCR), established in 1999, funds spinal cord injury research projects in New Jersey.

❖ **Since 2001, over \$38 million has been awarded to individual scientists at academic and research institutions.**

- 176 separate scientific research projects have been awarded; 142 scientific research projects have been completed.
- Progress made by researchers has been presented in abstracts, scientific conferences, symposia, and meetings.
- NJCSCR programs have enabled wider scientific interaction and numerous active research collaborations, many with out-of-state researchers.
- Success in achieving NJCSCR funding has resulted in academic and career advancement for New Jersey researchers, including doctoral dissertations.
- Over 50 applications to the National Institutes of Health, the National Science Foundation and other organizations based on NJCSCR grants have been made.

❖ **NJCSCR offered four grant programs in Fiscal Year 2013:**

- Individual Research Grants
- Exploratory Research Grants
- Postdoctoral and Graduate Fellowship Grants
- Spinal Cord Injury Techniques Training Travel Grants

❖ **NJCSCR 2013 Achievements:**

- Thirty-six applications requesting \$11.1 million were submitted.
- Nine awards were made in 2013 totaling \$2,964,646.
- Four Individual Research Grants totaling \$2,363,696, two Exploratory Research Grants totaling \$400,000, two Fellowship Grants totaling \$200,000, and one Spinal Cord Injury Techniques Training Travel Grant totaling \$950 were approved.

NJ Spinal Cord Registry:

- ❖ NJCSCR supports a central registry of spinal cord injured persons in New Jersey in cooperation with New Jersey Department of Health.
- ❖ The registry database provides resource for research, evaluation, and information on spinal cord injuries.
- ❖ All Level 1 trauma centers now collect and submit comprehensive data electronically.



INTRODUCTION



Spinal cord injury and paralysis has long been regarded as a virtually hopeless diagnosis with a grim prognosis. Only since World War II has the outlook brightened. New approaches to rehabilitation and modern medicines have extended life expectancy from mere months to years and even decades.

Many people with permanent injury now look forward to far more vital and productive lives. More recently, breakthroughs in research and new horizons in the life sciences are moving us closer towards finding cures for spinal cord injuries. This prospect is, however, not yet a reality. Spinal cord injury impacts individuals and

families across the state and nation. Though young men remain at greatest risk, the number of women and older people suffering spinal cord injury is increasing. Falls, traffic and worksite accidents are the major causes of injuries. Black and Hispanic populations suffer disproportionately.

The economic and human costs of these injuries remain huge. Better therapies are urgently needed and the task of research is more demanding than ever. Paralysis resulting from spinal cord injury may no longer be “an ailment not to be treated,” but the search for the answers remains among the greatest challenges to medical science and the healing arts.

NEW JERSEY’S COMMITMENT TO SPINAL CORD RESEARCH

The Spinal Cord Research Act (N.J.S.A. 52:9e-1 et seq.) created the New Jersey Commission on Spinal Cord Research and the New Jersey Spinal Cord Research Fund to support its activities.

New Jersey is a leader in supporting research aimed at repair of the damaged spinal cord. The New Jersey Commission on Spinal Cord Research, created in 1999 under New Jersey’s Spinal Cord Research Act, represents the successful culmination of years of determined effort to enlist New Jersey in the fight.

The NJCSCR provides research grant programs for both established scientists and younger researchers committed to the goals of spinal cord injury research. The Commission also supports the New Jersey Department of Health (NJDOH) in establishing a database of all spinal cord injured patients in New Jersey.

Now in its 14th year of operation, the NJCSCR has funded 176 scientific research projects and supported individual scientists at research institutions around the state. Its impartial and scientifically rigorous application and review process has helped make the NJCSCR vital to New Jersey’s scientific investigators in their pursuit of the development of effective therapies for spinal cord injury.



THE NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH

The NJCSCR is one of only nine publicly-funded organizations nationwide that, together with the National Institutes of Health, the Centers for Disease Control, the Veterans' Administration and a few other entities, provide the essential support for the research needed to develop treatments for spinal cord injury paralysis and the life-threatening secondary dysfunctions that accompany it.

Created as a semi-independent public body, the NJCSCR is "...allocated in, but not of..." the NJDOH. It is subject to all the administrative rules and procedures of NJDOH, but is not a part of the Department of Health and is not included in its budget.

The Commission establishes and oversees the operations of the grants process and other activities that are implemented by its administrative staff. Eleven uncompensated Commissioners are appointed by the Governor with the advice and consent of the Senate, and serve for three-year terms.

Five Commission seats are designated by statute to represent the state's major academic research institutions and stakeholders. Public members provide a diversity of backgrounds and interests united by a shared commitment to the cause of spinal cord research. Any qualified person wishing to be considered for appointment may submit his or her name to the Governor's Office of Appointments. The Commission will always have one or more individuals from each of the following institutions and categories:

- *The Commissioner of the NJDHSS, or designee (voting ex-officio member)*
- *Rutgers, The State University of New Jersey*
- *Spinal Cord Injury Model System (Kessler Foundation Research Center)*
- *Christopher & Dana Reeve Foundation (American Paralysis Foundation)*
- *Public Members (at least one spinal cord physician and a spinal cord injured individual)*

The NJCSCR holds public meetings at least four times a year. Two-thirds of sitting members constitutes a quorum for all purposes. Members are recused from discussing or voting on matters in which they may have a potential conflict. A Chair and Vice-Chairperson are elected annually and preside over all formal proceedings.

The NJCSCR also maintains standing committees that meet and provide an informal structure to discuss issues and proposals on an *ad hoc* basis in advance of presenting them to the full Commission.

ADMINISTRATION

The administrative office provides the vital linkages and machinery that implement the NJCSCR's programs and ensure the integrity of its operations. The office staff manages the day-to-day operations, including program administration, interaction with applicants and grantees, contract administration, budgeting and financial matters, record-keeping and reporting.



The office schedules and facilitates all activities, manages the scientific merit review process, negotiates with outside vendors, and maintains the necessary relationships within state government.

NEW JERSEY SPINAL CORD RESEARCH FUND

The work of the NJCSCR is supported entirely by a statutory one dollar surcharge on all traffic and motor vehicle fines or penalties. Similar sources of funding have been implemented successfully by several other jurisdictions – vehicular accidents are a significant cause of spinal cord injury.

Revenue is collected by the State Treasurer for deposit into the New Jersey Spinal Cord Research Fund. The NJCSCR funds all its grant programs and other activities entirely from this dedicated source. No part of the NJCSCR's operating budget is paid for out of New Jersey's general tax revenue.

MISSION AND GOALS

The NJCSCR implements the commitment of New Jersey to the international quest for cures for catastrophic spinal cord injuries. Through its grants programs and related activities, the NJCSCR reinforces New Jersey's preeminence as a center of biomedical research and a leader in neuroscience, neurotrauma and spinal cord research.

- *The NJCSCR supports meritorious research projects that advance the understanding of spinal cord injury and explore potential therapeutic strategies.*



- *The NJCSCR supports the progression of research from laboratory to animal and clinical applications.*
- *The NJCSCR programs enhance the reputation of New Jersey as a focus of research and increases its attractiveness to researchers and business.*

OBJECTIVES

To accelerate research that will deepen our understanding of spinal cord injury and open the way to interventions and cures for paralysis and associated conditions.

The NJCSCR has identified the following objectives:

- *Advance the field of spinal cord research in New Jersey by encouraging established scientists to apply their expertise to spinal cord research.*



- *Foster collaborative, interdisciplinary approaches to spinal cord research.*
- *Nurture future generations of spinal cord researchers by supporting young scientists and postdoctoral fellows.*
- *Prevent or treat secondary biological conditions resulting from spinal cord injury.*
- *Promote dissemination of the research findings generated by scientists supported by the NJCSCR.*

RESEARCH FUNDING PRIORITIES

The **NJCSCR Research Guidelines** set forth the Commission's scientific agenda, research criteria and areas of particular interest. They offer applicants detailed guidance and instruction on funding criteria and policies. The full text appears on the NJCSCR website: www.state.nj.us/health/spinalcord.

An array of grant programs are currently offered including Individual Research Grants, Fellowships, Exploratory Research Grants, and Spinal Cord Injury Techniques Training Travel Grants. Each of these programs is designed to support and encourage spinal cord research in New Jersey in a unique way. The NJCSCR is continually evaluating its programs and seeking ways to improve its performance and results.

The NJCSCR Research Guidelines

The New Jersey Commission on Spinal Cord Research will fund research activities that hold promise of developing effective interventions and cures for paralysis and other consequences of spinal cord injury and disease. The areas of research listed below highlight the focus of current NJCSCR emphasis and funding:

- *Studying strategies to promote neuronal growth and survival, encourage the formation of synapses, enhance appropriate myelination, restore axonal conduction, replace injured cells, or otherwise improve function after spinal cord injury.*
- *Evaluating efficacy of drugs and other interventions that prevent or reduce secondary neuronal injury or providing insight into the mechanisms causing progressive damage.*
- *Defining anatomical characteristics of spinal cord injury or disease in well-defined animal models and in the human spinal cord, specifically documenting the cellular systems vulnerable to injury or disease and the functional losses which occur as a result thereof.*
- *Elucidating biological or physical mechanisms underlying approaches to improve functions compromised by spinal cord injury, e.g., bladder, bowel, and sexual function, and alleviate chronic pain, spasticity, and severe hypertension.*
- *Developing strategies to prevent or treat secondary complications arising from injury or disease to the spinal cord.*
- *Developing innovative restorative rehabilitation strategies to promote recovery of biological function.*
- *Translating basic and pre-clinical findings into clinical application.*
- *Supporting the investigation of promising new approaches.*



OTHER ACTIVITIES

The NJCSCR is engaged in activities that promote awareness and interest in spinal cord injury and opportunities for research.

The NJCSCR supports the efforts of the New Jersey Department of Health’s Center for Health Statistics to establish a “*Spinal Cord Injury Registry*” - a centralized data base of a standardized data set collected and submitted by each treating hospital on each new case of spinal cord injury in New Jersey.

Such a registry is mandated by statute as a resource for research, evaluation, and information on spinal cord injuries. CHS provides an annual report on spinal cord injury in the state as well as periodic updates to the NJCSCR.

THE NJCSCR APPLICATION AND REVIEW PROCESS

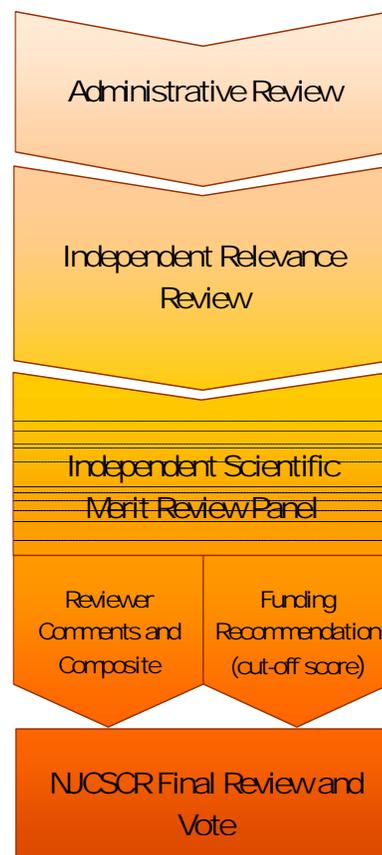
The NJCSCR grants review process was designed to emulate National Institutes of Health standards and procedures to provide an impartial and rigorous review. This effort has been largely successful and has earned respect from grantees and applicants. The NJCSCR application process is now entirely electronic utilizing the New Jersey System for Administering Grants Electronically (NJSAGE) grants management system, and is accessible through the NJCSCR website.

The on-line process ensures broad access, convenience and flexibility, and greatly reduces administrative workloads for applicants, the NJCSCR office, and the Scientific Merit Review Panel.

The NJCSCR administrative staff reviews all applications for completeness and accuracy and assists applicants in correcting errors or omissions.

Relevance to the overall goals of the NJCSCR is assessed by an expert panel who also recommend reviewers for each grant from a pool of over 100 highly qualified scientists.

Each application is reviewed and scored independently by two or three peers prior to discussion at the Scientific Merit Review Panel meeting; “triaged” applications are not discussed or scored.





The remaining applications are fully discussed and scored by the entire panel and given a composite score. The panel also suggests a cut-off point for funding. The scores, comments and funding recommendations are delivered to the NJCSCR for final consideration and vote.

The NJCSCR makes the final decision whether to fund each application by majority vote. The Commissioners pay close attention to the results of the Independent Scientific Merit Review, but retain discretion to take other factors into consideration in judging the merit of each application. Any application that was scored and not funded may be resubmitted with appropriate changes in the next grant cycle.

All applicants, regardless of the decision, receive “blinded” reviewer comments. These are often valuable and may help a researcher rethink a project or reframe a future application.

CURRENT GRANT PROGRAMS

Grant programs are designed to provide opportunities attractive to a wide range of researchers.

The Individual Research grant is designed to fund senior independent researchers. Fellowship grants offer encouragement to graduate students and post-doctoral researchers. The Exploratory Research grant enables researchers to apply innovative ideas from other areas of science to spinal cord injury and repair in order to acquire preliminary data and successfully apply for larger grants from the NJCSCR, National Institutes of Health, and elsewhere. The Spinal Cord Injury Techniques Training Travel grant offers applicants the ability to participate in a spinal cord injury techniques training course.

Inter-institutional and/or inter-state collaboration is strongly encouraged. Complete details on all programs are available on-line.

Individual Research Grants



- *Individual Research Grants support senior scientists to explore meritorious novel scientific and clinical ideas.*
- *Up to \$600,000 for up to three years (\$200,000 per year)*
- *Key goal is to enable established researchers to test and develop pilot data needed for future funding.*



Fellowship Grants

- *Postdoctoral and Graduate Student Fellowships engage promising young investigators in spinal cord research.*
- *All fellowships include an annual stipend, research allowance and travel budget.*
- *Post-doctoral Fellowships run for three years with a total award of \$150,000; (\$50,000 per annum)*
- *Graduate Fellowships run for two years with a total award of \$60,000 (\$30,000 per annum)*



Exploratory Research Grants



- *Enable independent investigators to apply their specific expertise to spinal cord research.*
- *Develop preliminary data needed to justify higher levels of funding.*
- *Apply innovative ideas from other areas to spinal cord research.*
- *Encourage inter-institutional and/or inter-state collaborations.*
- *Up to \$200,000 for a two-year non-renewable grant.*

Spinal Cord Injury Techniques Training Grants

- *Offers applicants the ability to participate in a spinal cord injury techniques training course.*
- *Courses are located at either Rutgers, The State University of New Jersey or at the National Institute for Neurological Disorders and Stroke sponsored Spinal Cord Injury Research Training Program held at the Ohio State University.*
- *A one-time per applicant non-renewable award of up to \$2,999 is provided.*





2001-2013 NJCSCR SUMMARY AND PERFORMANCE RECORD

Since 2001, the New Jersey Commission on Spinal Cord Research has funded 176 separate scientific research projects to scientists at New Jersey academic and research institutions. These awards represent an investment in spinal cord injury research of \$38,917,480 million.

The NJCSCR receives approximately 35 applications annually, approving 10 or more new awards, totaling between \$2-\$3 million.

As the NJCSCR continues to invest in spinal cord research, the number of New Jersey researchers interested in the field is growing.

Grant Applications

The NJCSCR has received 555 applications from professors, post-doctoral fellows, and graduate students at 14 New Jersey research institutions which cumulatively total \$151.7 million in grant requests.

The NJCSCR has explored a range of grant programs that provide opportunities for both very senior and younger researchers, and larger programs for establishing new spinal cord research facilities and support for professorships.

Applications for Individual Research grants typically account for about two-thirds of the total. Interest in both the Fellowship and Individual Research grant programs is historically strong. Fellowships offer the advantage of engaging the greatest number of scientists in spinal cord research for the least cost.

Grant Funding

Individual Research Project grants awarded to established investigators are the mainstay of spinal cord research in New Jersey. These projects aim at advancing the field in significant ways and are most productive as measured by publications and applications for additional funding.

The NJCSCR is also committed to bringing new researchers and promising students into the field as well. Its programs of graduate and post-doctoral Fellowships have been a success, in both numbers and the quality of applicants.

The Fellowship program is the NJCSCR's most cost-effective initiative, as measured by the number of researchers supported per grant dollar. The Individual Research grants generally support work of greater sophistication and potential importance.



New Jersey Qualified Research Institutions

Under The Spinal Cord Research Act, NJCSCR funds may only go to researchers affiliated with “**New Jersey Qualified Research Institutions**” (“NJQRIs”.)

Five institutions are named in the Spinal Cord Research Act and eleven others have been designated by the NJCSCR. These organizations provide a continuing source of interest and applications for NJCSCR funds.

Statutory NJQRIs

*Rutgers, The State University of New Jersey
University of Medicine and Dentistry of NJ
Kessler Foundation Research Center
Princeton University
Coriell Institute*

NJCSCR Designated NJQRIs

*New Jersey Institute of Technology
Veteran's Biomedical Research Institute
Stevens Institute
Drew University
JFK Medical Ctr. NJ Neuroscience Institute
Progenitor Cell Therapy, LLC
Seton Hall University
Wyeth Research
TRIM-edicine, Inc.
Rowan University
Hackensack University Medical Center*

Results and Achievements

Cure of spinal cord injury remains an elusive and frustrating goal. Years of intensive research and the investment of millions of dollars by NJCSCR and other organizations still leave much work to be done.

NJCSCR grantees and, to a lesser extent, grantee institutions have capitalized on the opportunities afforded by the availability of Commission funding through advancement of individual careers, increased institutional investment, and applying for additional outside funding. The NJCSCR has been a major factor in fostering this interest and continued involvement in spinal cord research within the State of New Jersey.

The NJCSCR continues to pursue its mission, encouraging and supporting spinal cord research in New Jersey. Many of its researchers can point to significant accomplishments.

- *Numerous scientific articles reporting on work funded by NJCSCR have appeared in peer-reviewed scientific publications, and additional articles are in preparation.*
- *Progress made by NJCSCR researchers has been presented in numerous abstracts, scientific conferences, symposia, and meetings.*



-
- *NJCSCR programs have enabled wider scientific interaction and research collaborations, many with out-of-state researchers.*
 - *Success in achieving NJCSCR funding has resulted in academic and career advancement for New Jersey researchers, including doctoral dissertations.*
 - *Over 70 applications to NIH, NSF and other organizations have been submitted, based in part on work funded by NJCSCR grants.*

The NJCSCR is committed to broadening its portfolio of institutional grantees and increasing the size and diversity of its funding activities. Through outreach activities, the NJCSCR encourages participation by all research organizations with an interest in spinal cord research.



2013 NJCSCR YEAR IN REVIEW

2013 Spinal Cord Research Grants Program

Ten applicants were awarded a total of \$2.9 million in 2013. Four Individual Research grants, two Exploratory Research grants, two Fellowships, and one Spinal Cord Injury Techniques Training Travel grant were funded after a careful review of the 36 applications submitted.

2013 Applications

2013 saw the New Jersey Commission on Spinal Cord Research in its 14th year of operation and its 18th cycle of grants. 36 applications were submitted with requests for funds totaling nearly \$11.2 million.

2013 Outreach and Development Efforts

The NJCSCR maintains an ongoing interest in expanding spinal cord injury research in New Jersey. Direct contacts, attendance at events and meetings, plus website and publications are some of the resources used to publicize NJCSCR grant opportunities throughout the state.

Publication of Grant Programs

Official Notices of Grant Availability advise interested parties of the grant programs. These were published in the *New Jersey Register* and in the New Jersey Department of Health's *Directory of Grant Programs*.

In Fiscal Year 2013, one grant cycle was offered; up to six million dollars was made available for spinal cord research projects.

2013 Grant Cycle

Grant Application Deadline: December 10, 2012

Award Notification Date: May 31, 2013

Available Grant Programs:

- *Individual Research Grants*
- *Exploratory Research Grants*
- *Fellowship Grants*
- *Spinal Cord Injury Techniques Travel Training Grants*



GRANTS PROGRAM FOR 2014

For Fiscal Year 2014, up to six million dollars has been allocated for spinal cord injury research projects.

The NJCSCR authorized one grant cycle for Fiscal Year 2014 offering Individual Research Grants, Fellowship Grants, and Exploratory Research Grants.

2014 Grant Cycle

Grant Application Deadline: December 10, 2013

Award Notification Date: May 30, 2014

Available Grant Programs:

- *Individual Research Grants*
- *Exploratory Research Grants*
- *Fellowship Grants*



NEW JERSEY SPINAL CORD INJURY REGISTRY

The Spinal Cord Research Act mandates the establishment and maintenance of a central registry of persons who sustain spinal cord injuries throughout the State. NJCSCR has been supporting the work of the Department of Health's Center for Health Statistics to create the mechanism for the collection and analysis of spinal cord injury data.

The registry will serve as a resource for research, evaluation, and information on spinal cord injuries. The Center for Health Statistics publishes an annual report providing data on spinal cord and brain injuries in New Jersey.

The following tables summarize data collected on non-fatal hospitalizations for spinal cord injury in New Jersey for the years 2010 – 2012.

	2010 - 2012	
<u>GROUPS</u>		
<u>SEX</u>	<i>n</i>	<i>Rate</i>
Males	876	6.7
Females	419	2.7
<u>AGE</u>	<i>n</i>	<i>Rate</i>
Under 15 Years	27	0.5
15-24 Years	132	3.9
25-34 Years	143	4.2
35-44 Years	135	3.7
45-54 Years	184	4.5
55-64 Years	222	6.8
65-74 Years	189	9.9
75-84 Years	165	14.0
85 Years & Older	98	17.7
<u>RACE & ETHNICITY</u>	<i>n</i>	<i>Rate</i>
White Non-Hispanic	777	4.0
Black Non-Hispanic	255	7.2
Hispanic	132	3.2
Asian/Pacific Islander	46	2.4
Other Race/Ethnicity	85	---



2010 - 2012		
<u>MECHANISM</u>	<u>n</u>	<u>%</u>
Motor Vehicle Occupants	188	14.5
Pedestrian	32	2.5
Pedal Cyclists	18	1.4
Motorcyclists	29	2.2
Unspecified MV Position	11	0.8
Other Transport Vehicles	22	1.7
Falls	596	46.0
Struck By/Against	40	3.1
Assault	72	5.6
Self-Inflicted	10	0.8
All Other Unintentional	114	8.8
All Other Unspecified	163	12.6

Inpatient hospitalizations for spinal cord injuries for New Jersey residents selected according to bill type in the NJ Hospital Discharge Data System.

Rates are calculated per 100,000 population and are either age-specific or age-adjusted using the 2000 US Standard Population.

Rates are not calculated for fewer than 20 observations.

Races are as reported. Hispanics can be of any race.

Data Sources: New Jersey Central Nervous System Injury Surveillance data;
NCHS Bridged Race Estimates for Population.



FINANCIAL STATEMENTS

The activities and programs of the NJCSCR are supported by the New Jersey Spinal Cord Research Fund as established by the Act. A one dollar (\$1.00) surcharge is imposed on all fines or penalties levied under the provisions of Title 39 of the Revised Statutes or any other motor vehicle or traffic violation. The revenue surcharge is collected and forwarded to the State Treasurer and deposited annually in an interest-bearing account designated as the New Jersey Spinal Cord Research Fund.

FUND BALANCE STATEMENT:			
	SFY 2013 <i>Projected</i>	SFY 2013 <i>Actual</i>	SFY 2014 <i>Projected</i>
Opening Fund Balance (July 1)	\$8,405,595	\$8,470,685	\$9,214,743
Revenues			
Assessments ¹	\$3,600,000	\$3,960,698	\$3,600,000
Investments Earnings - Interest ²	\$15,000	\$14,182	\$15,000
Total Revenue:	\$3,615,000	\$3,974,880	\$3,615,000
Total Funds Available	\$12,020,595	\$12,445,565	\$12,829,743
Disbursements and Expenses			
Disbursements to Grantees	\$6,030,000	\$2,964,646	\$6,030,000
Total Disbursements	\$6,030,000	\$2,964,646	\$6,030,000
Expenses			
Administrative & Office Expense	\$67,400	\$234,620	\$110,000
Professional Review Panel	\$50,000	\$31,556	\$50,000
NJCSCR Registry	\$0	\$0	\$0
Total Expenses	\$117,400	\$266,176	\$160,000
Total Disbursements and Expenses	\$6,147,400	\$3,230,822	\$6,190,000
Closing Fund Balance (June 30)	\$5,873,195	\$9,214,743	\$6,639,743
¹ Net revenue variance			
² Funds plus interest deposited annually in January			



2013 RESEARCH GRANT AWARDS

INDIVIDUAL RESEARCH GRANT RECIPIENTS:

Gail Forrest, Ph.D.
Kessler Foundation

Grant Award: \$574,976

Project Title: *Non-Ambulatory SCI Walk Using a Robotic Exoskeleton:
Effect on Bone and Muscle*

Functional gains after spinal cord injury (SCI) often plateau, leaving a person paralyzed and immobilized. There is a rapid wasting away of the muscle and bone in the lower limbs within the first six months of injury and osteoporosis often results. High fracture risk, especially about the knee, an energy imbalance leading to obesity and cardiovascular disease, urinary tract infection and skin issues such as pressure sores are often the result of muscle and bone deterioration and continued immobilization. These health issues are daily concerns, and affect the day to day quality of life of people who cannot walk following a spinal cord injury. The spinal cord injury is the primary injury, but the secondary consequences are often very challenging. Ultimately, treatment is expensive and often more expensive with short and long term medical consequences, and attendant costs.

Currently, the treatment of muscle and bone deterioration after SCI is very limited; therefore, there is a definite need to further understand the mechanisms of breakdown in the musculoskeletal system, and more importantly, find a clinical strategy to treat muscle and bone loss. Exoskeletons for assisted walking following spinal cord injury are novel robotic anthropomorphic mobile devices that are intended for rehabilitation, mobility and walking overground for those persons with SCI that are unable to walk. We are proposing that with continued walking overground with the device, muscle and bone will improve. We plan to test our hypothesis by allowing people to train or walk in the exoskeleton for 100 sessions, 5 times per week (1 hour/session). The device is easy to put on from a seated position and the skill of walking or stepping using the exoskeleton is relatively easy to learn. It is our intent to develop lines of research to show the benefits of walking overground in this device. These benefits include gains in muscle and bone, and an increase in general health and fitness for those persons who are 100% wheelchair reliant. This study identifies the progression of technology to enhance functional ambulation for persons with a spinal cord injury. This project will be completed at two sites: Kessler Foundation Research Center will be the lead site that will be under the direction of Gail F. Forrest, Ph.D. (Principal Investigator), and Spinal Cord Damage Research Center, James J. Peters, VA Medical Center under the direction of Ann M. Spungen, Ed.D. (collaborator). Both sites have exoskeletal-assisted walking programs. We plan to measure many bone and muscle outcomes before and after the training protocol to answer our research question. And, more importantly, we are going to try and understand the mechanisms of why the bone and muscle is lost after the injury.



Nancy Chiaravalloti, Ph.D.
Kessler Foundation

Grant Award: \$596,152

Project Title: *Impact of Age on Cardiovascular, Cerebrovascular and Cognitive Health in Spinal Cord Injury*

The population is getting older, it is reported that the number of individuals in the United States older than 65 increased 10 times over the past 100 years. Likewise, individuals with spinal cord injury (SCI) are also aging and more than 80% are older than 50 years. However, as the general population is getting older, they are living longer; this is not the case in people with SCI. In fact, persons with tetraplegia can expect to live 34 years less than an individual of the same age who is not injured.

The reasons for reduce life expectancy in the SCI population are not clear, but cardiovascular and cerebrovascular diseases were the leading causes of death from 1952-2001. As people with SCI get older they are faced with increased likelihood of diseases, but they also are faced with the secondary complications of the SCI; such as the inability to control heart rate and blood pressure. As a result, it is more difficult to prevent and treat diseases and illness in the SCI population, which may worsen disease progression and reduce life expectancy. In addition, cardiovascular and cerebrovascular dysfunction may negatively affect thinking (cognitive) capacities and these individuals are reported to have increased likelihood of memory, information processing and executive function impairments.

In the general population there is evidence which supports a link between these cognitive impairments and cardiovascular and cerebrovascular dysfunction. Because the SCI population is aging, improving cognitive abilities while reducing cardiovascular and cerebrovascular dysfunction would be expected to improve health and quality of life, and contribute to increased life expectancy.

Therefore, the objectives of this project are to compare cardiovascular, cerebrovascular and cognitive function among individuals with SCI, age-matched non-SCI (NS) and older NS individuals. The results will help guide interventional studies aimed at improving health and longevity in the SCI population.



Yi Ren, Ph.D.
Rutgers, The State University of NJ

Grant Award: \$592,568

Project Title: *Myelin Debris-derived Lipid Accumulation Modulates the Function of Macrophages in Spinal Cord Injury*

Macrophage activation and persistent inflammation are linked to the pathological process of spinal cord injury (SCI). There are mainly two types of macrophages: M1 (bad) and M2 (good) activation. M1 macrophages that produce pro-inflammatory cytokines act as an effector of cell killing. M2 macrophages are anti-inflammatory and contribute to wound healing and tissue-remodeling.

We demonstrated that infiltrated bone marrow derived macrophages migrated to the epicenter of injury, where they changed their M2 into M1 phenotype, which was induced by myelin debris generated in the injured spinal cord. There was striking defective lipid efflux in lesion site, which lead to the formation of foam cells and lipid plaques. These foam macrophages lost M2 phenotype and existed in the lesion site for a long period of time, which may contribute to the persistent inflammation because they showed a pro-inflammatory phenotype, enhanced neurotoxicity and impaired wound healing. Interestingly, there seems to be a negative correlation between lipid accumulation and the presence of M2 macrophages.

We therefore proposed a new concept that dysregulation of lipid efflux following macrophage phenotype switch may contribute to the pathological process of SCI. Approaches targeting reestablishment of the lipid homeostasis would be beneficial for the resolution of the inflammation.



Michael Matisse, Ph.D.

Grant Award: \$600,000

UMDNJ - Robert Wood Johnson Medical School

Project Title: *Role of Shh in Mediating Response of Adult Spinal Cord Stem Cells to Injury*

Spinal cord injury (SCI) in humans elicits a series of responses that serve two important roles: 1) to limit the extent of damage through reactive gliosis, and 2) to promote functional recovery through the generation of new cells to replace those lost as a result of trauma. Recovery from injury therefore requires that multiple, distinct cell types respond appropriately during both the acute response and prolonged recovery phases. Therapeutic strategies that are directed toward promoting recovery from SCI are based on one of two general approaches: cell replacement using transplantation of cultured "stem cells" that can produce specific derivatives, or encouragement of spinal cord resident stem cell populations to divide and differentiate. The latter approach has gained importance with the identification of adult CNS reservoirs containing quiescent, immature cells that can generate differentiated progeny following injury. In the spinal cord, cells with such properties have been identified in two locations: 1) scattered throughout the gray and white matter regions, and 2) within the ependymal zone (EZ) cell layer surrounding the central canal. Following injury, cells from both of these sources are induced to proliferate, and produce primarily glial derivatives (astrocytes and oligodendrocytes-OLs) that migrate toward the lesion site to play a role in the formation of the glial scar (reactive gliosis), restoration of the damaged blood-brain barrier, and re-myelination. However, the specific mechanisms involved in these important endogenous responses remain poorly understood and therefore cannot yet be fully exploited for therapeutic purposes in humans suffering from SCI.

We have recently obtained data indicating a novel role for the Sonic Hedgehog (Shh) pathway in establishing and/or maintaining glial stem cells in both the adult EZ and gray matter. This secreted signaling protein has been previously shown to play critical roles during embryonic development and also in maintaining adult neural stem cells in the brain; however its specific role in the spinal cord following injury has not been determined. Taken with experimental evidence which detected the production of Shh protein by spinal cord cells following contusion or demyelinating lesions, as well as studies showing that the local injection of Shh following SCI in rodent injury models can lead to improved functional recovery, we hypothesize that the Shh pathway plays a crucial role in mediating the response of adult spinal cord stem cells to SCI. The goal of the current proposal is to test this hypothesis in mice, which will allow us to combine genetic manipulation with experimentally controlled SCI. We will accomplish the goals of this project in two aims. In Aim 1, we will determine the requirement for Shh signaling in adult EZ stem cells following SCI, while in Aim 2, we will ask whether Shh signaling is required in parenchymal stem cells following SCI. Both aims will combine sophisticated conditional genetic manipulations to block Shh signal reception in adult spinal cord glial progenitor cells following SCI. The fate of genetically-labeled stem cells will then be monitored at various times during the response and recovery periods to ascertain whether they capable of generating the normal number of OLs and astrocytes in the absence of Shh signal reception. Together, these studies will help us better understand the important events that are involved in the response of spinal cord stem cells to injury and help lead to the development and implementation of therapeutic strategies directed at restoring function in humans suffering from SCI.



FELLOWSHIP GRANT RECIPIENTS:

Stephanie Pyonteck, Ph.D.

Grant Award: \$150,000

Rutgers, The State University of NJ

Project Title: *Regulation of Neuronal Mitochondrial Fusion by the Hypoxia Response Pathway Affects Functional Recovery & Survival Following Anoxic Stress*

Cells require oxygen and nutrients to make their own energy, which occurs in the subcellular powerhouse known as the mitochondria. The energy needs of neurons in the nervous system are dramatic, as high levels of cellular energy are required for the transmission of electrical signals in the brain and peripheral nervous system to allow for sensation and the control of movement. Following the initial trauma of spinal cord injury, swelling and decreased blood pressure impair blood flow and the delivery of oxygen and nutrients to the affected tissues, which is known as ischemia. Neurons are most acutely affected by ischemia following spinal cord injury because without oxygen and nutrients, neurons can no longer make more energy and they rapidly burn through their limited stored energy reserves. Thus, following energy depletion, the neurons rapidly begin to die. The massive amounts of neuronal cell death following spinal cord injury and the inability to effectively replace these cells often lead to permanent disability and paralysis with minimal chances for recovery.

Cells have many mitochondria to meet their energy needs, and mitochondria can exist either as small, individual units or fused together to function as a larger, more efficient network. Published research suggests that the interconnectivity of the mitochondrial network can affect how well cells are able to tolerate stress and if they are able to survive it. Using a well-established and transparent genetic model organism for studying neuron development and cell death, we are able to visualize the fusion and splitting of mitochondria in neurons in a more accessible model for what occurs in human neurons, and without the potential artifacts observed in a tissue culture system. We have found that oxygen deprivation triggers the breakdown of the mitochondrial network in neurons, and when oxygen is restored, mitochondria begin to fuse back together to restore the network. Similar findings have been reported in mouse and human neurons in response to ischemia, validating our model. We have also found that changes in an oxygen-sensing signaling pathway allow for neuronal mitochondria to “hyperfuse” and form a larger, more extensive network after oxygen deprivation. Importantly, this mitochondrial hyperfusion improves viability and speeds functional recovery of animals after long periods of oxygen deprivation, indicating that this hyperfusion can function as an inherent protective mechanism in neurons. Our goal is to begin to understand (1) the molecular mechanisms of how neurons control mitochondrial splitting and fusion in response to oxygen levels, and (2) how and why hyperfused mitochondria can protect neurons following oxygen deprivation. This basic research will potentially allow for the identification of novel therapeutic targets to improve neuronal survival of ischemia following traumatic neural stress in the hope of improving patient outcome and reducing the clinical burden of spinal cord injury.



Megan Damcott, Ph.D.
Kessler Foundation

Grant Award: \$50,000

Project Title: ***Quantitative Measure of Force During Electrical Stimulation:
An Exploratory Study***

Although basic science has provided critical insight regarding the treatment and prevention of musculoskeletal deterioration after spinal cord injury (SCI), the translation of this knowledge into clinical practice has yet to be accomplished. This project addresses the gap bridging the laboratory and clinic with the development of a quantitative measure which will allow for the translation of science into clinical practice. Prolonged immobilization decreases the quality of life in individuals with SCI. The absence of mechanical loading within these individuals has been widely accepted as a significant factor in the prevalence of bone loss and osteoporosis: increasing the risk of fracture and mortality rates. To minimize and prevent musculoskeletal deterioration, mechanical loading interventions which allow for periods of upright posture and weight bearing have been investigated. While decades of research have been dedicated to developing therapeutic interventions for the improvement of bone health, determining the optimal parameters (mode, intensity, frequency, duration) for an efficacious loading intervention has been difficult due to the complexity of bone physiology. Basic science has provided critical insight: bones adapt to the loads in which they are placed. Specifically, if the forces produced on the bone are within a genetically predetermined threshold range, growth and mineralization to strengthen or maintain bone is generated. However, the inability to effectively quantify the forces placed on the bone during loading interventions has prevented the translation of this knowledge into clinical practice. Therefore, this project directly addresses this gap by exploring the development of instrumentation which can be utilized to quantify the forces applied to the bone across loading interventions and provide insight to allow determination of the optimal parameters to reduce bone loss, improve quality of life and maximize therapeutic benefits.

In individuals with SCI, mechanical loading has been investigated during stance and electrical stimulation (ES). However, the efficacy of ES in bone has yet to be reported. A limitation of early studies investigating the efficacy of ES has been the inability to measure the contractile force applied to the bone to determine if the magnitudes of loading were within the effective threshold range to modulate bone loss. Therefore, methods have recently been developed to quantify the magnitude of loading through the measure of external forces and moments (EKEFs and EKEMs, respectively) at the knee during ES induced isometric contractions of the quadriceps muscle. The measured EKEFs and EKEMs are then applied to mathematical models to estimate the internal forces applied to the femur. While these methods have provided quantification of loading during ES interventions, the accuracy of the measures and clinical applicability of the instrumentation and protocols is limited as the models are two-dimensional or use theoretical anatomical measures. Therefore, the primary aim of this project is to explore the limitations of the current measurement methods with the development of novel instrumentation, which will provide three-dimensional EKEFs and EKEMs during ES induced contraction of the quadriceps muscle while in stance. Three-dimensional quantification of the forces and moments holds the potential to increase the accuracy of the calculation of the internal forces applied to the bone and provide insight critical for maximizing the clinical efficacy of interventions.



EXPLORATORY RESEARCH GRANT RECIPIENTS:

KiBum Lee, Ph.D.

Grant Award: \$200,000

Rutgers, The State University of NJ
Department of Chemistry & Chemical Biology

Project Title: *Enhanced Stem Cell Based Gene Therapy for Spinal Cord Injury Using Novel Magnetic Coreshell Nanoparticles*

Spinal cord injury (SCI) is one of the most common causes of disability in young adults, affecting approximately 12,000 people in the United States every year. SCI results in a number of cellular and molecular changes in and around the injury site, leading to a host of debilitating symptoms that result in increasing loss-of-function. In addition, gliosis at the injury site is a source of a variety of inhibitory factors that prevent the damaged neurons from regenerating. Given the complex damage caused by SCI and the intrinsically limited regenerative potential of the mammalian CNS, there is a strong clinical need for effective strategies to: 1) alleviate the inhibitory environment, 2) regenerate the destroyed neural cells, and 3) re-establish the damaged neuronal circuitry in the injury site.

To this end, stem cell transplantation has shown great promise in treating SCI. In animal models, transplantation of neural stem/progenitor cells (NSPC) improved motor functional recovery in SCI via neuroprotection. However, this treatment has been found to be associated with increased hypersensitivity and neuropathic pain, which greatly affects the quality of life after SCI. Loss of inhibitory interneurons after SCI is thought to be a major mechanism underlying this altered sensory function. Therefore, replenishing inhibitory interneurons by NSPC transplantation may be beneficial. Yet, even though NSPCs show great potential to become inhibitory interneurons experimentally in the lab, it is not clear whether this formation will occur after SCI transplantation. In turn, an improved stem cell therapy would entail finding a way to force the NSPCs to become inhibitory neurons in the injury site, while also exploiting their innate neuroprotective ability described earlier. In the proposed study, we have developed a nanotechnology-based approach to address these challenges. We propose to deliver specific genes into the NSPCs, which can then be activated after transplantation and direct the NSPCs to become inhibitory interneurons. This gene activation will be facilitated by the aid of a novel multifunctional magnetic core/shell nanoparticle (MCNP) system. The MCNP will provide three major advantages: 1) delivery of the gene vectors into the NSPCs, 2) spatial and temporal activation of the delivered genes, and 3) tracking of the NSPCs after transplantation. In this way, scientists and clinicians can harness the full potential of stem cells for an enhanced SCI treatment. Overall, our MCNP-based stem cell therapy is a hallmark of the next generation of SCI therapies that combine the benefits of nanotechnology and stem cell research.



Prabhas V. Moghe, Ph.D.

Grant Award: \$200,000

Rutgers, The State University of NJ
Department of Biomedical Engineering

Project Title: *Engineering Reprogrammed Neurons on Transplantable Scaffolds for Management of Spinal Cord Injury*

A major roadblock for the treatment of neurotraumatic disorders like spinal cord injuries is the lack of available neural tissue source that can be implanted at the site of injuries and lead to successful integration and restoration of sensory and motor functions of the spinal cord. Human neurons typically die when detached, which limits the possibility of harvesting healthy human neurons prior to transplantation to a patient. Human neural stem cells can be derived from a variety of cell sources, but neural stem cells do not efficiently differentiate to specific types of neurons and undifferentiated cells run the risk of becoming tumorigenic after transplantation in vivo. For all of these reasons, we propose to apply a novel approach to generate a human source of neurons and enrich the neuronal population using transplantable devices for transplantation.

The exploratory program takes on the challenge of reprogramming the behaviors of human somatic cell-derived stem cells (induced pluripotent stem cells) by transfecting these with neuronal transcriptional factor genes. The novelty of this program would be to improve the efficiency of neuronal reprogramming to yield sub-type specific motor neurons using minimal transfection using single factors and by harnessing combination of three-dimensional scaffold microenvironments (to select for neuronally maturing lineages) and presentation of biological signals (to retain the neuronal phenotypes).

To examine the efficacy of these neuronal constructs for healing spinal cord lesion, we will derive human iPSC-reprogrammed neurons using the 3-D constructs and then test the maturation and function of the neurons longer term.

As an exploratory program, this proposal sets the stage for design of transplantable devices containing rapidly reprogrammed neurons which would show high levels of survival and motor capacity upon implantation. In the long term, these insights could also help to develop appropriate human neuron-transplantation approaches in patients afflicted with spinal cord injuries.

**SPINAL CORD TECHNIQUES TRAINING GRANT RECIPIENT:****Stephen Kelly, Ph.D.**

Grant Award: \$950

NJ Neuroscience Institute at JFK Medical Center

Research in my laboratory is aimed at exploring the pathophysiology of and developing therapies for brain injury and related neurological disorders. My primary research goal is to develop a meaningful, widely applicable treatment for ischemic brain injury. I use a variety of approaches in this pursuit, including molecular, cellular, gene therapy, regenerative medicine (such as, stem cells, cell transplantation, enhancement of endogenous repair mechanisms), pharmacological, biomaterials and engineering techniques. I have a long-standing interest in spinal cord injury research (SCI) and strongly believe that my expertise and interests could be meaningfully translated to study this condition. Like stroke and traumatic brain injury, SCI is unpredictable and has a relatively rapid and inherently complex pathology that can, in time, result in a barren, acellular lesion surrounded by scar tissue. Moreover, many of the pathological features encountered during this transition and the barriers to meaningful treatment, repair and regeneration are also common to or similar to those faced in stroke.

There are two lines of work in my lab that I believe hold significant potential for SCI. The first of these explores the role of microRNAs (miRNAs) upon gene regulation in the ischemic and inflamed brain. We have identified a number of miRNAs that we believe can be targeted to reduce the degree of injury induced by these insults, and to enhance endogenous repair mechanisms. We have found that one of these miRNAs, miR-132, is significantly reduced by severe ischemia in vivo, but increased by neuroprotective bouts of ischemic preconditioning. Moreover, overexpression of miR-132 was found to protect cultured hippocampal neurons from ischemic and excitotoxic injury. As well as its potential neuroprotective role, miR-132 is induced by neuronal activity, contributes to dendritic plasticity, and plays a key role in synaptic integration and survival of newborn neurons in the brain. We hypothesize that miR-132 could be beneficial in SCI and will use our inducible miR-132 mutant mice to investigate this. The second line of investigation is exploring the utility of combining novel, microstructured biomaterials with neurons and stem cells to develop tailored 3D cellular networks that can be deposited into the ischemic cortex following stroke. We are generating tailored poly lactide nerve growth conduits using a combination of computer-aided design and 3D printing. These structures have been shown to support neural and stem cell growth and can be modified to release factors of interest (such as growth factors or anti-inflammatory molecules) to enhance cell survival and modify the host environment. While we continue to work toward using this approach to treat cortical stroke, we strongly believe that it may be far better suited to SCI. A New Jersey Commission SCI Techniques and Training grant would provide me with expert training, an opportunity to interact with potential collaborators in this field, and would kick-start this SCI work in my laboratory/department.