

NJCSCR 2018



NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH

Annual Report State Fiscal Year 2018



NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH

2018 ANNUAL REPORT

January 30, 2019

The Honorable Phil Murphy
Governor of New Jersey
Office of the Governor
State House - P.O. Box 001
Trenton, New Jersey 08625

Dear Governor Murphy:

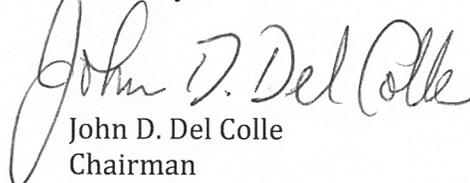
On behalf of the New Jersey Commission on Spinal Cord Research, and the citizens with spinal cord injury, it is our privilege to present the 2018 Annual Report.

Once again, the Commission has had an active and productive year. We have recently completed the 23rd annual competition for spinal cord injury research projects.

In 2018, the Commission awarded almost \$3 million in spinal cord injury research grant funding. Each of the funded research projects has the potential to contribute significantly to the development of treatments and cures for the paralysis and secondary complications that accompany spinal cord injury. These grants facilitate the basic research findings necessary to compete successfully for larger National Institutes of Health, and National Science Foundation awards. In addition, they help attract talented scientists and students to this exciting and promising field in New Jersey.

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

Sincerely,



John D. Del Colle
Chairman



**State of
New Jersey
Commission on
Spinal Cord
Research**

NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH



2018 ANNUAL REPORT



**New Jersey Commission on Spinal Cord Research
Members of the Commission**

**John Del Colle, Chairperson
Peter W. Carmel, M.D.
Susan P. Howley
Carolann Murphy, PA
Michael J. Rhode
Loran C. Vocaturo, Ed.D.
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Commission Personnel

Christine Traynor, Administrator
Mary Ray, Fiscal Manager

ACKNOWLEDGEMENTS

The New Jersey Commission on Spinal Cord Research would like to express its sincere appreciation to all present and past Commission members, and the New Jersey Department of Health staff.

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TABLE OF CONTENTS

Members of the New Jersey Commission on Spinal Cord Research.....	i
Acknowledgements.....	i
Executive Summary.....	1
Introduction.....	2
New Jersey Spinal Cord Registry	3
New Jersey’s Commitment to Spinal Cord Research	3
New Jersey Commission on Spinal Cord Research.....	3
Mission and Goals.....	3
Objectives	4
Membership and Organization	5
Administration	6
Funding	6
Research Funding Priorities	6
Grant Application and Review Process.....	7
Current Grant Programs.....	8
2001-2018 Summary and Performance Record	10
New Jersey Qualified Research Institutions	11
Commission Achievements	11
2018 Year In Review	12
Grant Programs For 2019	13
Financial Statement.....	14
2018 Research Grant Awards	15
Attachment A – Spinal Cord Research Act.....	43

EXECUTIVE SUMMARY

NJ COMMISSION ON SPINAL CORD RESEARCH 2018

The New Jersey Commission on Spinal Cord Research was established in 1999 to fund spinal cord injury research projects in New Jersey.



Since 2001, the New Jersey Commission on Spinal Cord Research (Commission) has awarded over \$53 million to individual scientists at academic and research institutions and approved 229 separate scientific research projects.

- Since 2001, 186 scientific research projects have been completed.
 - Progress made by researchers has been presented in abstracts, scientific conferences, symposia, and meetings.
 - Commission programs have facilitated wider scientific interaction and numerous active research collaborations, along with out-of-state researchers.
- Success in achieving Commission funding has resulted in academic and career advancement for New Jersey researchers, including doctoral dissertations.
 - Numerous successful applications to the National Institutes of Health, the National Science Foundation and other organizations based on the Commission's grants have been made.

❖ Four grant programs were offered in Fiscal Year 2018:

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

❖ 2018 Achievements:

- Forty-one applications requesting a total of \$10.2 million were submitted.
- Sixteen awards were made in 2018 totaling \$2,983,547.
- Three Individual Research Grants totaling \$1,347,253, seven Exploratory Research Grants totaling \$1,388,294, four Fellowship Research Grants totaling \$240,000, and two Spinal Cord Injury Techniques Training Travel Grants totaling \$8,000 were approved.

INTRODUCTION

NJ COMMISSION ON SPINAL CORD RESEARCH 2018

INTRODUCTION

This report is written in accordance with the enabling Statute, which stipulates that the Commission shall provide a report to the Governor and Legislature on the status of the Commission's activities and the results of its funded research efforts.¹

The Spinal Cord Research Act created the New Jersey Commission on Spinal Cord Research and the New Jersey Spinal Cord Research Fund to support its activities. This Act resulted from the collaborative efforts of people with spinal cord injury and their families, clinicians, scientists, public officials, and representatives of research, rehabilitation and non-profit organizations.

BACKGROUND

Spinal cord injuries can be some of the most devastating and life-changing injuries a person can sustain. Depending on the severity and location of the injury, a spinal cord injury can cause paralysis and death. Spinal cord injury has long been regarded as a virtually hopeless diagnosis with a grim prognosis. However, innovative approaches to rehabilitation and modern medicine have extended life expectancy from months to years and even decades. Many people with permanent injury can now live vital and productive lives. More recently, breakthroughs in research and new horizons in the life sciences are moving us closer to finding cures for spinal cord injuries.

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 a spinal cord injury is increasing. Motor vehicle crashes remain the leading cause of spinal cord injury, followed by falls and acts of violence such as gunshot wounds.²

The economic and human cost of these injuries remains huge. Better therapies are 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.

1. N.J.S.A. C.52:9E-1 et seq. Enabling statute is attached hereto as “Attachment A.”

2. National Spinal Cord Injury Facts and Figures at a Glance. <https://www.nscisc.uab.edu/Public/Facts%202016.pdf>.

MISSION AND GOALS

NJ COMMISSION ON SPINAL CORD RESEARCH 2018

NEW JERSEY SPINAL CORD REGISTRY

The Spinal Cord Research Act mandated the establishment of a central registry of persons who sustain spinal cord injuries other than through disease, whether or not the injury results in a permanent disability. The Registry captures incidence and prevalence data on spinal cord injuries and serves as a resource for research, evaluation and information on spinal cord injuries.

NEW JERSEY'S COMMITMENT TO SPINAL CORD RESEARCH

New Jersey is a leader in funding research aimed at the repair of spinal cord injuries. The Commission, created in 1999 under New Jersey's Spinal Cord Research Act, represents the successful culmination of years and determined effort to enlist New Jersey in the fight. The Commission offers research grant programs for both established scientists and younger researchers committed to spinal cord injury research.

Now in its 19th year of operation, the Commission has funded 229 scientific research projects and supported individual scientists at research institutions in New Jersey. Its impartial and scientifically rigorous application and review process has helped make the Commission vital to New Jersey's scientific investigators in their pursuit of developing effective therapies for spinal cord injury.

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

NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH

1. MISSION AND GOALS

The Commission's mission is to encourage and promote scientific research projects that advance the understanding of spinal cord injury and explore potential therapeutic strategies at qualifying research institutions in New Jersey. Through its grant programs and related activities, the Commission reinforces New Jersey's preeminence as a center of biomedical research, and a leader in neuroscience, neurotrauma and spinal cord research.

MISSION AND GOALS

NJ COMMISSION ON SPINAL CORD RESEARCH 2018

Simply stated, the Commission's goals are:

- To support meritorious research projects that advance the understanding of spinal cord injury and explore potential therapeutic strategies.
- To support the progression of research from bench to bedside.
- To enhance the reputation of New Jersey as a focus of biomedical research, and
- To facilitate the initiatives of New Jersey scientists to obtain larger grants from sources such as the National Institutes of Health and the National Science Foundation.



2. OBJECTIVES

The Commission is committed to accelerating research to develop effective interventions and cures for disabilities such as paralysis that are associated with spinal cord injury. Its primary objectives are:

- To develop and implement spinal cord research grant programs.
- To solicit, review, and administer grant awards in support of scientifically meritorious research projects.
- To promote development of spinal cord research projects that focus on treatments, cures, and on those that prevent or treat secondary biological conditions resulting from spinal cord injury, and
- To support the progression of research from laboratory to animal and clinical applications.

More specifically, the Commission works to:

- 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, and
- Disseminate the research findings generated by scientists supported by the Commission.

MEMBERSHIP AND ORGANIZATION

NJ COMMISSION ON SPINAL CORD RESEARCH 2018

3. MEMBERSHIP AND ORGANIZATION

Created as a semi-independent public body, the Commission is “...allocated in, but not of...” the New Jersey Department of Health. The Commission is subject to all the administrative rules and procedures of the Department, but it is not a part of the Department’s budget.

The Commission establishes and oversees the administrative operations of the grant-making process as well as other program 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 three-year term.

The Commission will always have one or more individuals from each of the following institutions and categories.

The Commissioner of the New Jersey Department of Health, or designee, Rutgers, The State University of New Jersey; one representative of the federally designated Spinal Cord Injury Model System (Kessler Foundation); one representative from the American Paralysis Association (Christopher & Dana Reeve Foundation); and six public members - at least one licensed physician and one person with a spinal cord injury.

All public members shall be residents of the State, or otherwise associated with the State and should provide a diversity of backgrounds and interests united by a shared commitment to the cause of spinal cord research.³

Any qualified person wishing to be considered for appointment may submit his or her name to the Governor’s Office of Appointments.⁴

Public meetings are held at least four times a year. Members are recused from discussing or voting on matters in which they may have a potential conflict. A Chair and Vice Chairperson are elected and preside over all formal proceedings.

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

3. New Jersey Statute (N.J.S.A.52:9E-1 et seq.)

4. New Jersey Statute (N.J.S.A.52:9E-1 et seq.) on the following website at: <http://www.state.nj.us/governor/admin/bca>

RESEARCH FUNDING PRIORITIES

NJ COMMISSION ON SPINAL CORD RESEARCH 2018

4. ADMINISTRATION

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

Administrative staff schedule and facilitate all activities, manage the scientific merit review process, negotiate with outside vendors, and maintain the necessary relationships within state government.

5. FUNDING

Under the enabling Statute, the work of the Commission is supported entirely by a one-dollar surcharge on all New Jersey traffic and motor vehicle fines or penalties. Monies generated from these fines or penalties are collected by the State Treasurer for deposit into the New Jersey Spinal Cord Research Fund. All grant programs and other activities are funded entirely from this dedicated source. No part of the operating budget is paid for out of New Jersey's general tax revenue.

RESEARCH FUNDING PRIORITIES

The Research Program Guidelines set forth the Commission's scientific agenda, research criteria and areas of interest.⁵ The guidelines offer applicants detailed guidance and instruction on funding criteria and policies.

The Commission funds research activities that hold promise of developing effective interventions and cures for paralysis and other consequences of spinal cord injury and disease. An array of grant programs is offered including Individual Research Grants, Fellowship Research Grants, Exploratory Research Grants, and Spinal Cord Techniques Training Travel Grants. The areas of research listed below highlight the focus of current emphasis and funding to:

- Study 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.
- Evaluate efficacy of drugs and other interventions that prevent or reduce secondary neuronal injury or providing insight into the mechanisms causing progressive damage.

5. The full text appears on the website at: www.nj.gov/health/njcsr.

GRANT APPLICATION AND REVIEW PROCESS

NJ COMMISSION ON SPINAL CORD RESEARCH 2018

- Define 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.
- Elucidate 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.
- Develop strategies to prevent or treat secondary complications arising from injury or disease to the spinal cord.
- Develop innovative restorative rehabilitation strategies to promote recovery of biological function.
- Translate basic and pre-clinical findings into clinical application.
- Support the investigation of promising new approaches.

GRANT APPLICATION AND REVIEW PROCESS

The grants review process was modeled on the National Institutes of Health standards and procedures to provide an impartial and rigorous review of research proposals.⁶ This effort has been largely successful and has earned respect from grantees and applicants.

Application Process

The grant application process is now entirely electronic utilizing the State of New Jersey's System for Administering Grants Electronically (SAGE).⁷ The online process ensures broad access, convenience, flexibility and greatly reduces administrative workloads for applicants, the Commission office, and the Scientific Merit Review Panel.

Grant Review Process

The grant review process consists of a three-step review.

- First, all grant applications are reviewed by the Commission's administrative staff to ensure compliance with New Jersey Statutes and regulations and to ensure accuracy.
- Second, an independent relevance review is conducted by a three-person panel appointed by the office of the Commission. The panel determines the relevance of all applications to the Commission's mission, priorities and Research Program Guidelines, and will assign scientific reviewers for each proposal that meets the relevancy requirements. In the event the panel determines that an application does not meet those

6. <https://www.nih.gov/sites/default/files/about-nih/nih-director/testimonies/nih-policies-procedures-promoting-scienc>

7. <https://njsage.intelligrants.com/Login2.aspx?APPTHEME=NJSAGE>

GRANT APPLICATION AND REVIEW PROCESS

NJ COMMISSION ON SPINAL CORD RESEARCH 2018

requirements, the application will be triaged, and will not be forwarded for independent scientific merit review.

- Third, members of the Independent Scientific Merit Review Panel convene to evaluate all grant applications forwarded by the Independent Relevance Review Panel applying the criteria described below. This panel will assign scores to each application and make funding recommendations to the Commission. If it is determined that an ad hoc expertise is needed, additional scientific referees may be used.

Recommendations and Authorization

The Independent Scientific Merit Review Panel will forward its recommendations to the Commission for final review and action. Grants triaged by either the Independent Relevance Review Panel and/or the Independent Scientific Merit Review Panel will not be forwarded to the Commission and will not be funded.⁸

CURRENT GRANT PROGRAMS

Grant programs are designed to provide scientific opportunities attractive to a wide range of researchers. Awards are intended to promote collaboration among spinal cord researchers in New Jersey and encourage innovative research. The intent is not to provide long term support for research. It is expected that this initial support will lead investigators to acquire the necessary levels of preliminary data, so they may compete successfully for federal grant support.

The Individual Research Grant is designed to fund senior independent researchers, while the Fellowship Research Grant offers encouragement to graduate students and postdoctoral researchers. The Exploratory Research Grant enables researchers to apply innovative ideas from other areas of science to spinal cord injury and repair, and the Spinal Cord Injury Techniques Training Travel Grant offers applicants the ability to participate in training courses on spinal cord injury techniques.

Inter-institutional and/or inter-state collaboration is strongly encouraged. Complete details on all grant programs are available on the Commission's website.⁹

8. The authority to authorize or not authorize grants is fully vested in the Commission according to New Jersey Statute (N.J.S.A. C.52:9E-1).

9. <https://nj.gov/health/spinalcord/>

GRANT PROGRAMS

NJ COMMISSION ON SPINAL CORD RESEARCH 2018

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).
- A key goal is to enable established researchers to test and develop pilot data needed for future funding.

FELLOWSHIP RESEARCH 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.
- Postdoctoral 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.
- Allow up to \$200,000 for a two-year non-renewable grant.

SPINAL CORD INJURY TECHNIQUES TRAINING TRAVEL GRANTS

- Offer applicants the ability to participate in training courses on spinal cord injury techniques.
- Applicants may select a course on their own or attend a course at either Rutgers, The State University of New Jersey, or the Spinal Cord Injury Research Training Program located at Ohio State University.
- A one-time per applicant non-renewable award of up to \$4,000 is provided.

SUMMARY AND PERFORMANCE RECORD

NJ COMMISSION ON SPINAL CORD RESEARCH 2018

2001-2018 SUMMARY AND PERFORMANCE RECORD

Since 2001, the Commission has invested \$53,294,802.90 in New Jersey scientists. Scientific interest in the field of spinal cord injury research remains strong due to the ongoing investment of these funds.

Approximately 38 grant applications are received annually; approval of ten or more new grant awards totaling \$2 to \$3 million are made.

Due to its continued investment in spinal cord injury research, the number of New Jersey researchers interested in the field is growing.

GRANT APPLICATIONS

To date, the Commission has received 714 applications by scientists at New Jersey academic and research institutions. These awards represent an investment in spinal cord injury research, which cumulatively total \$198.9 million in grant funding requests.

The Commission has explored a range of grant programs that provide opportunities for both senior and young 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. These projects are aimed at advancing the field in significant ways and result in scientific publications as well as additional funding.

GRANT FUNDING AWARDS

Individual Research 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 Fellowship Research Grant program is the Commission's most cost-effective initiative, as measured by the number of researchers supported per grant dollar. The Commission is committed to bringing new researchers and promising students into the field. Its programs of graduate and postdoctoral Fellowships have been a success, in both numbers and qualified applicants.

QUALIFIED RESEARCH INSTITUTIONS

NJ COMMISSION ON SPINAL CORD RESEARCH 2018

NEW JERSEY QUALIFIED RESEARCH INSTITUTIONS

Under the Spinal Cord Research Act, funds may only go to researchers affiliated with “New Jersey Qualified Research Institutions.” The following organizations have been designated as Qualified Research Institutions by the New Jersey Commission on Spinal Core Research.

- o Rutgers, The State University of New Jersey
- o Kessler Foundation
- o Princeton University
- o Coriell Institute for Medical Research
- o New Jersey Institute of Technology
- o VA New Jersey Health Care System & Veterans Biomedical Research Institute
- o Stevens Institute of Technology
- o Drew University
- o Hackensack Meridian Health JFK Medical Center – The Neuroscience Institute
- o Progenitor Cell Therapy, LLC
- o Hackensack Meridian School of Medicine at Seton Hall University
- o Wyeth Research/Pfizer
- o TRIM-edicine, Inc.
- o Rowan University
- o Cooper University Hospital & Cooper Medical School of Rowan University
- o Hackensack Meridian Health
- o Celvive, Inc.
- o Montclair State University
- o St. Joseph’s University Medical Center

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

COMMISSION ACHIEVEMENTS

Although a cure for spinal cord injury remains elusive, the investment of millions of dollars by the Commission and other organizations has led to a wealth of new knowledge and insights that hold promise for effective therapies and cures. Below is a summary of the Commission’s achievements:

- Grantees and their institutions have capitalized on the opportunities afforded by the availability of Commission funding. Scientific knowledge and careers have been advanced as well as institutional revenue and scientific achievements.

2018 YEAR IN REVIEW

NJ COMMISSION ON SPINAL CORD RESEARCH 2018

- The Commission has been a major factor in fostering the interest and continued involvement in spinal cord research within the State of New Jersey.
- Numerous scientific articles reporting on the work funded by Commission have appeared in peer-reviewed scientific publications, and several articles are about to be published. Progress made by researchers has been presented in numerous abstracts, scientific conferences, symposia, and meetings.
- The grant programs have facilitated greater scientific interaction and research collaborations, both in New Jersey and nationally.
- Success in achieving funding has resulted in academic and career advancement for New Jersey researchers, including doctoral dissertations. Applications to the National Institutes of Health, the National Science Foundation, and other organizations have been submitted, due to the work funded by the Commission.

2018 YEAR IN REVIEW

In 2018 the Commission witnessed its 19th year of operation and 23rd grant cycle. Forty-one applications were submitted with requests for funds totaling \$10.2 million.

2018 Overview and Applications

Sixteen applicants were awarded a total of \$2,983,547 in 2018. Three Individual Research Grants totaling \$1,347,253, seven Exploratory Research Grants totaling \$1,388,294, four Fellowship Research Grants totaling \$240,000, and two Spinal Cord Techniques Training Travel Grants totaling \$8,000 were funded.

2018 Outreach and Development Efforts

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

Publication of Grant Programs

Official Notices of Fund Availability advise interested parties of the Commission's grant programs. These notices are published annually on the Commission's website and in the New Jersey Department of Health's Directory of Grant Programs.¹⁰ In Fiscal Year 2018, one grant cycle was offered; resulting in the availability of \$3.1 million for spinal cord research projects.

10. NJ Department of Health Directory of Grant Programs: www.healthapps.state.nj.us/noticeofgrant/noticegrants.aspx

2018 YEAR IN REVIEW

NJ COMMISSION ON SPINAL CORD RESEARCH 2018

2018 Grant Cycle Information

Grant Application Deadline: December 11, 2017

Award Notification Date: June 30, 2018

Available Grant Programs:

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

GRANT PROGRAMS FOR 2019

For Fiscal Year 2019, an estimated \$3.1 million has been allocated for spinal cord injury research projects. The Commission authorized one grant cycle for Fiscal Year 2019 offering Individual Research Grants, Fellowship Research Grants, Exploratory Research Grants and Spinal Cord Injury Techniques Training Travel Grants.

2019 Grant Cycle Information

Grant Application Deadline: **December 10, 2018**

Award Notification Date: **April 30, 2019**

AVAILABLE GRANT PROGRAMS:

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

FINANCIAL STATEMENT

The activities and programs of the Commission are supported by the New Jersey Spinal Cord Research Fund as established by the Act. A one-dollar surcharge is imposed on all fines or penalties from motor vehicle or traffic violations. This revenue surcharge is collected and forwarded to the New Jersey State Treasurer. The funds are then deposited annually in an interest-bearing account designated as the New Jersey Spinal Cord Research Fund.

FINANCIAL STATEMENT

NJ COMMISSION ON SPINAL CORD RESEARCH 2018

STATE FISCAL YEAR 2018 FUND BALANCE STATEMENT:

	SFY 2017 <i>Projected</i>	SFY 2018 <i>Actual</i>	SFY 2019 <i>Projected</i>
Opening Fund Balance (July 1)	\$794,449	\$653,546	\$1,183,527
Revenues			
Assessments ¹	\$3,600,000	\$3,758,471	\$3,720,000
Investments Earnings - Interest ²	\$15,000	\$68,028	\$50,000
Total Revenue:	\$3,615,000	\$3,826,499	\$3,770,000
Total Funds Available	\$4,409,449	\$4,480,045	\$4,953,527
Disbursements and Expenses			
Spending Plan Reduction			
Disbursements to Grantees ³	\$3,600,000	\$2,983,547	\$3,800,000
Total disbursements	\$3,600,000	\$2,983,547	\$3,800,000
Expenses			
Administrative & Office expense	\$290,000	\$305,251	\$310,000
Professional Review Panel	\$35,000	\$34,242	\$42,000
NJCSER Registry	\$0	\$0	\$0
Total expenses	\$325,000	\$339,493	\$352,000
Total Disbursements and Expenses	\$3,925,000	\$3,323,040	\$4,152,000
Closing Fund Balance (June 30)	\$484,449	\$1,157,006	\$801,527

¹Net revenue variance

²Funds plus interest deposited annually in Jan.

³Funds for Multi-year grants

2018 RESEARCH GRANT AWARDS - INDIVIDUAL RESEARCH GRANTS

Below is a project summary of the Individual Research Grant recipients:

CSCR18IRG013 - \$557,782

Nancy Chiaravalloti, Ph.D.

Kessler Foundation

120 Eagle Rock Avenue, Suite 100

East Hanover, NJ 07936

nchiaravalloti@kesslerfoundation.org

973-324-8440

Project Title: *Examining Behavioral and Neural Aspects of Implicit Procedural Learning Performance in Individuals with Spinal Cord Injury.*

This study will characterize implicit procedural learning deficits in SCI and explore cognitive and neural underpinnings of this ability, which is critical for optimal learning in rehabilitation.

Traumatic spinal cord injury (SCI) is a significant public health concern as it affects approximately 11,000 individuals in the US per year, who incur lifetime costs ranging from \$1.1 to \$4.7 million each. Recent research indicates that many individuals with SCI have problems with cognition. Cognitive problems can be detrimental for daily living and limit independence, thus leading to poor health outcomes and low quality of life. An important aspect of cognition is our ability to be able to learn things and perform them automatically, such as for example, learning to ride a bike or type on a keyboard efficiently. This cognitive process is called implicit learning and relies not only on the brain but also involves the spinal cord. Implicit learning is very important for achieving successful rehabilitation outcomes. It is during rehabilitation individuals try to relearn lost function, so they can do certain things automatically again. Thus, deficits in implicit learning can greatly hinder rehabilitation in individual with SCI.

Despite its direct relevance to rehabilitation, little is known about implicit learning in individuals with SCI and how their brain functions when implicit learning is required. Thus, the objective of the proposed study is to examine implicit learning in individuals with SCI. The proposed study utilizes functional magnetic imaging (fMRI) and neuropsychological testing to examine implicit learning in individuals with SCI, how implicit learning is related to other cognitive processes, and whether implicit learning relies on different brain regions in comparison to healthy individuals. The results of this investigation will lay the basis for the development of informed treatment strategies to improve implicit learning in persons with SCI as the development of the most effective intervention relies upon a complete and multifaceted understanding of the sources of the deficit.

2018 RESEARCH GRANT AWARDS - INDIVIDUAL RESEARCH GRANTS

Below is a project summary of the Individual Research Grant recipients:

CSCR18IRG014 - \$589,471

Jeanne Zanca, Ph.D.

Kessler Foundation

1199 Pleasant Valley Way

West Orange, NJ 07052

jzanca@kesslerfoundation.org

973-324-3558

Project Title: *Informing Identification of Neuropathic Pain Phenotypes in People with SCI*

The proposed study will provide the preliminary data needed to design, fund, and implement the large-scale, multi-center studies that are required to establish neuropathic pain phenotypes.

WHY IS THIS STUDY BEING DONE? Neuropathic pain is a type of pain that is associated with injury or malfunction of the nervous system. This common complication of SCI usually develops in the first-year post-injury. Neuropathic pain decreases quality of life and is very difficult to treat. Neuropathic pain characteristics (the way it feels, when it is better or worse, what changes in sensation accompany the pain, etc.) vary widely among people with SCI. There are many types of medicines for neuropathic pain that work in different ways, and we do not know which medicines are best for which types of neuropathic pain. We expect that people with SCI who are similar in how their sensory systems are functioning and how their pains feel are likely to have similar causes for their pain. We need a way to identify groups of people who are similar to one another in their pain-related characteristics (their “neuropathic pain phenotype”) so that we can test different medicines in these groups of people and find the ones that work best for their particular type of pain.

WHAT WILL THE STUDY TEACH US? Identifying subgroups of people whose neuropathic pains have common features (their “neuropathic pain phenotype”) requires studies with large numbers of people that can only be done if several research centers or hospitals work together. To determine how many people we need to enroll in such a study, we need to estimate the percent of people who will likely develop neuropathic pain in the first year and what type of pain they develop (pain at the level of their spinal cord injury or pain below that level). We also need to know how many people may drop out of the study. Other important information that is needed to plan a future study includes which characteristics of pain are different among people with different types of pain, because these characteristics will help us define pain phenotypes. Finally, we need information about how sensory and pain characteristics change over time to identify the kinds of information we should collect in a large-scale study to identify characteristics that can predict the start or end of neuropathic pain and to understand how neuropathic pain phenotypes may change over time.

2018 RESEARCH GRANT AWARDS - INDIVIDUAL RESEARCH GRANTS

WHAT WILL HAPPEN IN THE STUDY? In this study, we will enroll 54 adults with new, traumatic SCI who are receiving rehabilitation at Kessler Institute for Rehabilitation. The participants will have three evaluations: one each at 1, 6, and 12 months after SCI. During these evaluations, participants will (1) complete questionnaires to describe the presence of pain and its characteristics, (2) be examined by a doctor to classify the type of SCI they have, and (if applicable) what type of pain(s) they have developed, and (3) undergo an assessment in which different kinds of stimulation (warm, hot, cold, dull, sharp) will be provided to the skin to see how their body's sensory system is responding.

HOW WILL THIS STUDY BENEFIT PEOPLE WITH SCI? The proposed study will provide the information we need to conduct large-scale studies to identify neuropathic pains with common features ("neuropathic pain phenotypes"). In turn, these phenotypes can be used to study different medicines in different types of pain so that we can determine which medicines are effective for which pains, and provide physicians with the evidence they need to match patients to the treatments that are most likely to be helpful to them. Better treatment of neuropathic pain will substantially improve quality of life for people with SCI.

2018 RESEARCH GRANT AWARDS - INDIVIDUAL RESEARCH GRANTS

Below is a project summary of the Individual Research Grant recipients:

CSCR18IRG007 - \$600,000

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Project Title: *Microencapsulated Nanoparticles and Genetically Modified MSC for Treatment of SCI*

Chemically transfected and PLGA alginate co-encapsulated MSC will reduce glial scarring and provide anti-inflammatory and neuroregenerative factors for SCI therapy.

Each year 12,000 new cases of spinal cord injuries (SCI) are reported throughout the U.S with the total number of patients exceeding 1 million, and over 6000 of these reside in NJ. The life changing consequences of SCI are not only due to the initial mechanical injury but the secondary events that follow the initial catastrophic event. The primary mechanical trauma initiates a secondary cascade of events, resulting in inflammation, scar tissue generation and ultimately the inability of the damaged neuronal axons to reconnect. Hence destruction of spinal cord tissue ensues, with functional losses that are life changing both physically and financially. Thus far, molecular treatments which focus on controlling inflammation, disrupting scar tissue formation or promoting axonal regeneration, have not demonstrated sufficient clinical efficacy and therefore, there is a significant need for the development of new multi-modal therapies.

An expanding body of literature evidence suggests that transplanted multi-functional mesenchymal stromal cells (MSC) can improve functional SCI outcomes as they secrete a plethora of anti-inflammatory cytokines and tissue regenerative growth factors. However, limitations with direct implantation of MSC include the fact that millions of infused MSC are needed to offset the loss of cells to non-targeted tissues and decay in response to the complex injury environment. To address this concern, our lab previously developed an alginate encapsulation (eMSC) approach that sustains MSC viability and promotes constitutive secretion of a panel of anti-inflammatory factors. Alginate is a cost effective, non-immunogenic, FDA-approved material that has been utilized extensively for a variety of stem cell differentiation and cell immobilization protocols. While these cells can significantly reduce tissue inflammation post-SCI, they are less effective at promoting neuronal regeneration because they do not directly control scar tissue formation, nor do they

2018 RESEARCH GRANT AWARDS - INDIVIDUAL RESEARCH GRANTS

secrete large enough levels of neuroregenerative factors such as Brain Derived Neurotrophic Factor (BDNF), one of the molecules which has been shown to extend neuronal axons after SCI.

Therefore, we propose to augment eMSC function by transfecting the cells with a safe, non-viral vector that will promote the secretion of chondroitinase, an enzyme which can impede scar tissue formation. We will stabilize the enzyme by co-encapsulating our MSC with nanoparticles that contain the sugar, Trehalose, which is known to preserve protein enzymatic and molecular function. In addition, we will also include nanoparticles containing BDNF to improve the regenerative function of our cell therapy. Therefore, we expect to generate a novel, multi-modal and cost-effective cell therapy for SCI treatment.

2018 RESEARCH GRANT AWARDS - EXPLORATORY RESEARCH GRANT RECIPIENTS

Below are the project summaries of the Exploratory Research Grant recipients:

CSCR18ERG028 - \$194,306

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973-324-8458

Project Title: *Using Eye-Tracker based Cognitive Assessments to Examine Cognitive Functions in Spinal Cord Injury*

This project aims to develop and test an eye-tracking based (“hands-free”) cognitive assessment to overcome the challenges imposed by upper limb motor dysfunction common in spinal cord injury. Cognitive functions (the ability to execute mental operations) are often impaired among persons with spinal cord injury (SCI) and are estimated to affect up to 60% of persons who live with SCI. One of the biggest challenges when developing protocols to assess cognitive functioning in persons with SCI is that many of the measures require upper limb function to respond properly (e.g. hand pointing, typing, squeezing, etc). In fact, in our ongoing studies examining cognitive functions in SCI, funded by the New Jersey Commission on Spinal Cord Research, enrolled participants demonstrated significant difficulties executing cognitive tasks that require a motor response.

Clinicians and researchers are thus limited in regard to the available tests they can use to assess cognitive functions in persons with SCI. This is particularly important because a detail assessment of cognitive abilities is essential to fully understand the impact of the SCI and plan an effective multidisciplinary rehabilitation program. Thus, it is fundamental that we develop new methods to assess cognitive functions that can be use with all individuals with SCI, independent of their level of motor functioning.

The present proposal aims to develop and test an eye-tracker based (“hands-free”) cognitive assessment that instead of using the upper limbs to provide a response, requires participants to provide responses by fixating their eyes in specific locations on a monitor. This technology has been used in the past with high success in other populations with similar motor disabilities. This is an innovative project that will allow clinicians and researchers to assess cognitive functions in persons with SCI independently of upper limb functioning. It will have a huge impact on our ability to assess and understand cognitive impairments in SCI. A detailed evaluation of cognitive functions is fundamental to understanding who may need to engage in cognitive rehabilitation programs and thus this project will significantly contribute to improved care and increased quality of life of those who live with SCI. The proposed project will directly contribute to the assessment and treatment

2018 RESEARCH GRANT AWARDS - EXPLORATORY RESEARCH GRANT RECIPIENTS

of a secondary condition resulting from SCI by applying a new approach to cognitive assessment, thus directly addressing the goals of the NJCSCR. We will meet the proposed objective through a 2-phase study. Phase I will develop an eye-tracker based cognitive assessment (ETCA) and execute a proof-of-principle study with 10 healthy controls (HC). Phase II will assess the sensitivity and usability of the ETCA in 20 individuals with SCI and 20 HC, and will also examine the impact of cognitive impairment on employment and quality of life in SCI. The development of a comprehensive neuropsychological evaluation that is completely motor-free (“hands-free”) is fundamental to allow us to: (1) examine the prevalence of cognitive impairments associated with SCI, an under - studied area; (2) understand the impact of cognitive impairments on employment and quality of life in SCI; and (3) develop rehabilitation programs which can have a significant positive impact on the life of those who live with SCI. Thus, our proposal not only targets a relatively under-studied area in SCI care, but also has the potential to directly contribute to improved care of those who live with SCI - a priority for the NJCSCR. The findings resulting from this study will be used as leverage to apply for and obtain additional funding from federal and non-federal institutions to run a more comprehensive study (larger sample size) examining the efficacy and sensitivity of the eye-tracker based cognitive assessment in SCI and thus contribute to better and more efficient assessment practices of cognitive functions in SCI.

2018 RESEARCH GRANT AWARDS - EXPLORATORY RESEARCH GRANT RECIPIENTS

Below are the project summaries of the Exploratory Research Grant recipients:

CSCR18ERG004 - \$199,988

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973-324-3520

Project Title: *Cortical Control of Walking; Brain Plasticity Following Exoskeleton Training in Incomplete Spinal Cord Injury*

This exploratory study aims to detect brain signals during walking and determine the effect of exoskeleton training on brain plasticity using mobile brain imaging techniques. Despite the significant advancements in the rehabilitation interventions in spinal cord research, recovery of walking after spinal cord injury is still a challenge. In this proposal, we suggest that the brain plays a significant role in the control of walking, at least in the intention and planning to move. Studying the brain control of walking is fundamental as a basic science question and for the advancement of spinal cord research. Hence, we intend to use mobile imaging (in specific Electroencephalography (EEG)) techniques to establish the relationship brain activity and walking in able-bodied and individuals with sustained incomplete Spinal Cord Injury (iSCI), and study the change in brain activity after rehabilitation intervention using exoskeleton-walking robot (EWR).

Ten able-bodied individuals and ten individuals with iSCI subjects will be recruited for a single EEG testing session to record brain and muscle activity while the subjects are sitting, standing, and walking in an open space environment. Similarly, a group of 8 iSCI subjects, who are receiving training using exoskeleton walking robots at Kessler Foundation, as part of a federally funded project, will be tested using EEG before and after 20 and 40 sessions of training. Data will be collected and analyzed similar to able-bodied data, and statistical tests will be applied to contrast the cortical and cortico-muscular activity between the three testing sessions (before and after 20 and 40 hours of training). EEG data will be analyzed to establish the correlation between brain activity and sitting, standing, and each phase of walking. Further, connectivity within the brain (between brain regions that controls movement), and between the brain and the muscles will be studied. Statistical tests will be applied to compare the brain activity and coherence in brain and muscle activity in able-bodied and iSCI participants and study how this activity and coherence changes in iSCI participants after training. We will also look into possible effect of using an exoskeleton on brain and muscle activity in both able-bodied and iSCI participants, and if this effect changes based on the type of exoskeleton assistance during walking. In able-bodied subjects,

2018 RESEARCH GRANT AWARDS - EXPLORATORY RESEARCH GRANT RECIPIENTS

we hypothesize that the brain initiates the intent to walk and contribute to the initiation and planning of steps and that the connectivity within the brain and between the brain and the peripheral muscles varies according to the phase of the walking cycle. In the iSCI subjects, we expect to find weaker cortical activity during standing and walking than in able-bodied subjects. After exoskeleton assisted walking training, we expect a reorganization in this activity. Finally, we expect that brain activity will be higher during walking with lower levels of robot-assistance since the individual will have more control on walking.

In summary, this proposal aims to apply brain imaging techniques to study the neural correlates of walking in able-bodied and iSCI subjects and explore the potential modulatory effect of exoskeleton training on brain activity. The aims of this study agree with the NJCSCR objective to “facilitate the application of innovative ideas from other areas of science to the challenges of spinal cord injury repair.” This study also meets the NJCSCR priority to study strategies to promote neural plasticity, since it is the first study to use brain imaging to study change in connectivity within brain and between the brain and muscles after exoskeleton assisted walking training in iSCI, which is an indirect measure of formation of new direct and indirect connections in the brain and between the brain and the muscles. This study will provide pilot data to start larger research projects that look into the use of innovative rehabilitation strategies to promote the recovery of brain-muscle connectivity and to translate these findings into clinical settings.

2018 RESEARCH GRANT AWARDS - EXPLORATORY RESEARCH GRANT RECIPIENTS

Below are the project summaries of the Exploratory Research Grant recipients:

CSCR18ERG018 - \$194,000

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Project Title: *Mitochondrial Calcium Homeostasis and Translatable Outcomes in Spinal Cord Injury*

Energetic and mitochondrial stress lead to secondary injury after SCI, which can be mitigated by early stage mitochondrial treatment to protect energy production and improve SCI outcome. Every year approximately 11,000 people sustain a traumatic spinal cord injury (SCI) in the United States, which results in over 200,000 people living with debilitating levels of chronic physical disabilities. New Jersey accounts for at least a few thousands of surviving SCI patients. While spinal injuries occur at different levels, cervical spinal injuries are the most frequent (about 62%) (<http://www.uab.edu/medicine/sci/>). SCI patients are clinically monitored using radiological and sometimes with functional imaging of the spinal cord and the brain combined with behavioral assessments of sensory and motor abilities. If treatments directed against SCI are to advance, they need to be tested for their effectiveness in restoring spinal circuit functions and its brain functional connectivity. Furthermore, relevant animal models of cervical SCI need to be characterized using similar clinical biomarkers applied in cervical SCI patients using imaging-intensive approaches. Towards this goal, we pioneered the application of functional neuroimaging (i.e., imaging certain physiological changes in response to neuronal activity in a non-invasive manner in the intact subject) using optical imaging and magnetic resonance imaging (MRI) technologies. We demonstrated brain functional changes after traumatic brain injury (TBI) in a rat model to evaluate treatments targeting mitochondria, which are subcellular organelles that generate energy molecules within cells. We discovered that facilitating mitochondrial function by improving its metabolism improved TBI outcomes. As similar excitotoxic (over excitability of neurons resulting in their death) secondary injury mechanisms exist in the brain and spinal cord, proposed exploratory studies will target spinal cord mitochondrial function by maintaining its energy metabolic capacity and ion homeostasis, which are depressed during the early stage (hours to few days) after injury. Functional imaging will be performed to assess spinal cord gray/white matter microstructure and vascular function through blood flow changes with and without mitochondrial

2018 RESEARCH GRANT AWARDS - EXPLORATORY RESEARCH GRANT RECIPIENTS

treatments and correlated with brain connectivity changes. Metabolomic, histologic and behavioral assessment with and without mitochondrial treatment will also be obtained and correlated with imaging. The proposed studies will develop robust and translatable approaches for preclinical assessment of cervical SCI, which is the most prominent type of SCI. The developed imaging intensive approach will significantly help new treatment development and efficiently test therapies improving mitochondrial function for cervical SCI patients.

2018 RESEARCH GRANT AWARDS - EXPLORATORY RESEARCH GRANT RECIPIENTS

Below are the project summaries of the Exploratory Research Grant recipients:

CSCR18ERG015 - \$200,000

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848-445-1780

Project Title: Role of MARCKS-derived Peptide in Functional Recovery after Spinal Cord Injury

Impact of a MARCKS peptide known to bind to regeneration conducive PSA glycan will be studied in spinal cord injured mice receiving this peptide by minimally invasive controlled delivery to the injury.

Cell adhesion molecules are not simply a “glue” between cells, but ensure that the right cells connect with each other not only during development of the nervous system but also in learning and memory and regeneration in the adult. The search for and identification of the functions of cell adhesion molecules in regeneration is of prime importance for implementing cures. We have been able to identify a new pro-active adhesion molecule (called MARCKS) which interacts with another pro-active structure (a sugar, called polysialic acid). This sugar, attached to adhesion molecules, is important for recovery of the nervous system after trauma. In parallel with elucidating the functions of the active site of MARCKS, we will search for small compounds that mimic the beneficial functions of MARCKS to improve functional recovery after spinal cord injury. Having shown in preliminary data that MARCKS has the potential to be beneficial in mouse spinal cord injury, we now plan to gain more insights into the mechanisms by which this molecule functions. We also aim at identifying small organic compounds that mimic the functions of MARCKS with the hope that they can be targeted to the injured nervous system in clinical trials. Our studies will be important not only for many citizens of New Jersey, but also worldwide.

2018 RESEARCH GRANT AWARDS - EXPLORATORY RESEARCH GRANT RECIPIENTS

Below are the project summaries of the Exploratory Research Grant recipients:

CSCR18ERG009 - \$200,000

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Project Title: Modulating CD4 T Cell Helper Function as a Therapeutic Response to Spinal Cord Injury

The role of CD40L in driving inflammation in spinal cord injury. We plan to investigate the therapeutic effects of decreased expression of CD40L in a mouse model of spinal cord injury (SCI). The spinal cord is a group of nerves that run from the brain down the vertebral column. The cord connects the brain with the rest of the body, making it an essential component for proper function in vertebrates. One important aspect of SCI that can lead to further damage is the inflammatory response that occurs following the injury. This inflammatory response is a result of many different cell types that reside in the central nervous system as well as cells, including CD4 T cells that enter the spinal cord from the blood. The primary function of CD4 T cells is to “help” other cell types carry out critical immune functions. One important way that they do this is by expressing a molecule on their surface called CD40L that interacts with CD40 expressed on many cell types in the injury site. They also express critical molecules called “cytokines” that inform other cells to respond in a particular way. The interaction between CD40L and CD40 is known to result in the expression of many different immune modulators; many of which exacerbate the injury and make recovery more difficult. Importantly, we have developed a mouse model that expresses less CD40L due to a mutation in the gene that alters the expression of the CD40L protein. Because we have not deleted CD40L, we find that CD4 T cells can still participate in helper function but not to the extent of unmutated CD4 T cells that express normal levels of CD40L.

We will use this mouse model to analyze a number of parameters of SCI. First, we will look at how this mutation affects the cells that are expressing inflammatory mediators that are detrimental to recovery. Second, we will determine which cell types are the most vulnerable to reduced levels of CD40L. Third, we will measure functional recovery in neurons from the site of injury using techniques that measure both their ability to survive and specific electrical responses of the nerve cells that are indicative of cells that are still able to function. We expect novel information from these studies to reveal the significance of CD40-CD40L in SCI recovery and lead to new knowledge regarding the use of this pathway in developing future therapeutics for SCI treatment.

2018 RESEARCH GRANT AWARDS - EXPLORATORY RESEARCH GRANT RECIPIENTS

Below are the project summaries of the Exploratory Research Grant recipients:

CSCR18ERG017 - \$200,000

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Project Title: A Device-assisted Surgical Procedure to Provide a Controlled Biophysical Environment for Spinal Cord Regeneration

To obtain spinal cord regeneration by a new surgical procedure centered on an implantable degradable device which will provide a protective biophysical environment. The spinal cord transmits signals back and forth to the brain and the rest of the body. Millions and millions of small cellular cables, the “nerve fibers”, are assembled to form the spinal cord. This key structure is protected inside a robust canal (the “spinal canal”) formed by the vertebral bones (the “spinal column”). However, major trauma can break even this strong bony protection. Sometimes it is an external body that produces the damage (a bullet in a gunshot wound); other times fractured vertebrae can produce bony fragments that literally cut the spinal cord into pieces. Blood pouring out from ruptured vessels (inside and outside the spinal cord) floods the spinal canal and its surroundings. A reparative process starts to take place immediately, but it is similar to attempting to repair a power cable during a hurricane. Furthermore, cells which provide a relay for signal transmission (neurons) and cells which provide support (glial cells), start to suffer from the reduction in oxygen flow and nutrients. As they die, they release toxic chemicals, adding to the process of inflammation caused by the trauma. The inflammatory process results in a coarse rubbery scar which creates a wall between the nerve stumps: they cannot reunite anymore. Surgery can help in these dramatic injuries by controlling the hemorrhage, clearing the field from debris, and stabilizing the vertebral fractures; however, it is not possible to suture the fibers end-to-end (they are often thinner than a hair). A first therapeutic achievement was the use of a potent anti-inflammatory drug (methyl-prednisolone) to mitigate the inflammatory reaction. More recently, a second advance has been the development of artificial gels that are placed in the gap and provide a scaffold for fibers to regenerate, drugs to be delivered and transplanted stem cells to differentiate and replace dead cells. We want to provide a third step forward by developing a surgical technique which will allow the placement of an artificial device around the lesion.

2018 RESEARCH GRANT AWARDS - EXPLORATORY RESEARCH GRANT RECIPIENTS

This device will create a kind of shelter where the reparative process will take place while the inflammation process rages outside. The device will provide a significant barrier against the cells, fibroblasts in particular, that will converge at the site of the lesion. Its action, however, is not that of a pure sealing (that will be impossible at the cellular level and that will be not totally desirable for the regenerating cord) but more a “deception”; fibroblasts attack the device in numbers, so very few will remain available to interfere with the regeneration process taking place inside. This approach may be technically demanding (it is not an easy surgery) and challenging from a biomaterial point of view (the device must be degradable and disappear after some time). However, it has proven to be effective in treating single peripheral nerve lesions where artificial devices, in the shape of conduits, are routinely used in the clinic. We want to translate this approach to the spinal cord, as if it was a giant single nerve. Our proposed approach may greatly enhance the probability of success for acute surgical treatment. It will easily integrate and extend the efficacy of many current treatments. It may likely open, in the future, new possibilities to revive the surgical approach to chronic lesions.

It has been esteemed that more than 6,000 New Jersey residents now live with traumatic spinal cord injury (nationally the number totals 200,000+ and about 300 of the estimated 11,000+ new spinal cord injury cases in the US every year are New Jersey residents). It is often outlined that direct medical costs are exorbitant. Indirect costs on victims and their families are harder to quantify, but place a significant burden on individuals, local and state resources. The toll in emotional costs and quality of life is incalculable (NJCSCR website).

2018 RESEARCH GRANT AWARDS - EXPLORATORY RESEARCH GRANT RECIPIENTS

Below are the project summaries of the Exploratory Research Grant recipients:

CSCR18ERG007 - \$200,000

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Project Title: *Role of GDF10 in Promoting Axonal Regeneration and Functional Recovery after Spinal Cord Injury*

We will develop a targeted gene transfer methodology against spinal cord injury by exploiting the neuronal growth-promoting potential of GDF10 in promoting axonal regeneration and functional recovery.

Spinal cord injury (SCI) occurs when there is damage from trauma, loss of normal blood supply, or a mass effect due to compression from tumor or infection. Unlike other parts of the body, the regenerative ability of the spinal cord is relatively poor. The inability of axons to regenerate after SCI is attributable to a combination of effects of the non-permissive extrinsic factors including myelin proteins and chondroitin sulfate proteoglycans (CSPGs), and cell-autonomous intrinsic factors including cAMP, RhoA, Krüppel-like factors, mammalian target of rapamycin (mTOR) and phosphatase and tensin homolog (PTEN). However, the factor(s) that may be triggered to promote the initiation of a molecular growth program and axonal sprouting in SCI are largely unknown.

In the present project, we propose to explore the possibility of developing a novel therapeutic approach to SCI by exploiting the neuronal growth-promoting potential of growth differentiation factor 10 (GDF10), a potential gene belongs to the transforming growth factor beta (TGF- β) superfamily. GDF10 regulates several molecular signaling systems to induce a neuronal growth state. Our focus on GDF10 as a therapeutic target after SCI is based on the observation that GDF10 regulates major axonal regenerative cues including PTEN, phosphoinositide 3-kinase (PI3K) and suppressor of cytokine signaling 3 (SOCS3). Thus, we hypothesize that up-regulation of GDF10 will mitigate PTEN-mediated inhibition of axonal regeneration. We will also examine the specific effects of GDF10 on other major regulatory signaling cascades of axonal regeneration, the PI3K, SOCS3 and PTP pathways in vitro and in vivo. In order to up-regulate GDF10 in experimental animals, we will deliver GDF10 gene via lentivirus into the sensory-motor cortex and dorsal raphe nucleus areas of the brain, and evaluate the subsequent progress of axonal regeneration and

2018 RESEARCH GRANT AWARDS - EXPLORATORY RESEARCH GRANT RECIPIENTS

functional recovery after SCI. Findings from this project will help to clarify the specific role of GDF10 in axonal regeneration and functional recovery after SCI and establish a basis for pursuing GDF10 as a therapeutic strategy for spinal cord injured patients.

2018 RESEARCH GRANT AWARDS - FELLOWSHIP RESEARCH GRANT RECIPIENTS

Below are the project summaries of the Fellowship Research Grant recipients:

CSCR18FEL010 - \$60,000

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908-672-8038

Project Title: *Orthostatic Blood Pressure and Arterial Stiffness in Persons with SCI: The Effect of the Renin-Angiotensin-Aldosterone System*

This investigation seeks to determine if increased reliance on the RAAS for orthostatic BP regulation contributes to differences in supine AS in individuals with SCI and age-matched controls.

In New Jersey, approximately 6,000 residents suffer from traumatic injuries or disease that damage the spinal cord. With advances in acute medical care, longevity has increased in persons with SCI; however, morbidity due to cardiovascular disease (CVD) occurs at an earlier age compared to the general population. Additionally, individuals with chronic SCI are at a heightened risk of CVD due, in part, to autonomic nervous system (ANS) dysfunction, physical inactivity and increased inflammatory processes. Arterial stiffness (AS) is recognized as an independent risk factor for CVD and, specifically, pulse wave velocity (PWV) has been proven to be a valid tool to predict and track structural arterial changes that reflect arteriosclerosis. Evidence has shown that persons with SCI have increased AS compared to uninjured able-bodied controls; however, possible contributors to this increase are not yet fully understood.

After a SCI, sympathetic control in the regions below the lesion level are severely disrupted; however, parasympathetic function is preserved. Due to the dissociation between the two systems, those with lesions above T6 experience low resting blood pressure (BP) and further decreases in BP when changing postures, which is called orthostatic hypotension (OH). Decreased plasma epinephrine and norepinephrine (NE) has been noted in individuals with cervical lesions when compared to individuals with thoracic injuries and controls. Additionally, lower levels of NE have been found to be associated with an increased incidence of OH in persons with SCI. As a consequence, individuals with high-level injuries have a heightened reliance on renin-angiotensin-aldosterone-system (RAAS) to maintain and stabilize BP. A mechanism for increased AS in the uninjured population is over activation of the RAAS.

2018 RESEARCH GRANT AWARDS - FELLOWSHIP RESEARCH GRANT RECIPIENTS

Angiotensin II (ANG II), a hormone produced through RAAS, creates vascular stiffening by reducing elastin, promoting collagen formation and increasing inflammation.

Therefore, the study aims are: 1) To investigate the influence of orthostatic change of BP and NE on the RAAS responses to orthostasis; and 2) To determine if increased reliance on the RAAS for orthostatic BP regulation contributes to differences in supine AS in individuals with SCI. The goal of this project is to lead to a greater understanding of the additional risk factors that contribute to CVD in order to help guide clinical treatment, which may ultimately result in preservation of cardiovascular health and longevity of New Jersey residents who have sustained a SCI.

2018 RESEARCH GRANT AWARDS - FELLOWSHIP RESEARCH GRANT RECIPIENTS

Below are the project summaries of the Fellowship Research Grant recipients:

CSCR18FEL006 - \$60,000

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908-938-9822

Project Title: *Schwann Cells in Combination with GAG-mimetic Scaffolds for Spinal Cord repair*

To develop a novel glycosaminoglycan (GAG) mimetic conduit to promote axonal growth in spinal cord injuries.

As a part of the central nervous system (CNS), the spinal cord transmits motor information to various parts of the body as well as receives sensory information from these parts. Spinal cord nerve tissue has a limited capacity to regenerate after spinal cord injury (SCI). In the United States, the annual incidence of SCI is 54 cases per million of the population annually, which is often because of a sports injury, motor vehicle accident, or even a fall. SCI is a devastating heterogeneous neurological condition with no effective treatment at the present time to restore the lost body function. After injury, the spinal nerve tissue undergoes a sequence of physiological changes followed by cascade of reactions at the affected site which eventually lead to a hostile environment for axon regeneration and so permanent disability. The extracellular matrix (ECM) is a 3D structural framework provides a suitable environment for cells in the central nervous system. The components of ECM have signaling and regulatory roles in the function of cells in the central nervous system to support a healing and regenerative response. Tissue engineered scaffolds mimicking the native extracellular matrix (ECM) may be a promising strategy to promote axonal growth. Among all different components of ECM, proteoglycans, which are proteins with covalently bound sulfated glycosaminoglycans (GAGs), have been shown to be an important component. Recent studies have shown chondroitin sulfate (CS) proteoglycans play an important role in axonal growth. They can either inhibit or promote axonal growth depending upon the degree and pattern of sulfation. GAGs have been shown to interact with and regulate growth factors, chemokines and cytokines. Recent work has shown that growth factor binding to GAGs is strictly controlled by the pattern and degree of sulfation. We have developed a GAG mimetic, sodium cellulose sulfate (NaCS), which can be tailored to have varying degree and pattern of sulfation similar to native GAGs, CS-C and CS-D, which have sulfates in the 6th carbon position

2018 RESEARCH GRANT AWARDS - FELLOWSHIP RESEARCH GRANT RECIPIENTS

and in both the 2nd and 6th carbon positions, respectively. Schwann cells (SCs) are of interest to be used in combination with this scaffold since they secrete neurotrophic factors stimulating neuron survival and extension of axons. This study proposes to evaluate the novel use of SCs in combination with a GAG-mimetic scaffolds for spinal cord repair.

2018 RESEARCH GRANT AWARDS - FELLOWSHIP RESEARCH GRANT RECIPIENTS

Below are the project summaries of the Fellowship Research Grant recipients:

CSCR18FEL009 - \$60,000

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Project Title: *mTOR Signaling in Oligodendrocytes after SCI*

The mTOR signaling pathway may play a critical role in preserving and repairing white matter after SCI, which would make it a potential therapeutic target for promoting functional recovery post-SCI.

Spinal cord injury (SCI) is a major burden that often requires substantial medical intervention and lifelong care, with an estimated 285,000 patients currently in the U.S. alone. In SCI, patients experience decreased quality of life and loss of function due to partial or complete paralysis, which is a result of damage to nerve cells, or neurons, in the spinal cord. However, this initial damage to neurons is not the only problem that contributes to SCI pathology: SCI also leads to loss of myelin, a specialized cell membrane that insulates the central nervous system (CNS) to enable efficient signaling and promotes neuronal health. Without the support of myelin, neurons are at risk for further degeneration, which in turn exacerbates functional loss after SCI. Because of this, finding methods to prevent this demyelination could limit functional loss after SCI. Interestingly, even if neurons can be stimulated to regenerate, functional recovery may be minimal without the presence of healthy myelin. Myelin repair, or remyelination, can occur after SCI, but this repair is often incomplete and may limit functional recovery for patients. In addition to finding methods to minimize demyelination, it is important to identify potential therapeutic targets that can promote remyelination to maximize functional recovery. Specifically, we need to understand how we can promote the survival of oligodendrocytes (OLs; the cells that make myelin), the production of new OLs, and the production of myelin after SCI. We have discovered that the mTOR signaling pathway is critical in maintaining healthy OLs and myelin in the CNS. Based on published and new preliminary data, I hypothesize that mTOR signaling promotes white matter sparing and repair after contusion SCI by reducing OL susceptibility to insult and enhancing OL and myelin production, making downstream effectors promising targets for promoting myelin repair and functional recovery after SCI. To address this hypothesis, I will determine how 1) mTOR affects demyelination and loss of function post-SCI, and 2) mTOR affects remyelination and functional

2018 RESEARCH GRANT AWARDS - FELLOWSHIP RESEARCH GRANT RECIPIENTS

recovery post-SCI. The results from completing this proposal will aid in determining whether the mTOR signaling pathway represents a potential novel target in OLs for limiting functional loss and promoting functional recovery after SCI.

2018 RESEARCH GRANT AWARDS - FELLOWSHIP RESEARCH GRANT RECIPIENTS

Below are the project summaries of the Fellowship Research Grant recipients:

CSCR18FEL005 - \$60,000

Christopher Rathnam

Rutgers University

Biomedical Engineering

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Project Title: Fabrication of Biodegradable Peptide Nanoparticle Artificial Transcription Factor for the Treatment of Spinal Cord Injury

This project focuses on developing a highly efficient biodegradable nanoparticle that can regulate gene expression to treat spinal cord injury with a long-term goal to repair motor function.

The goal of this proposal is to develop a new technology that is called NanoScript for the treatment of spinal cord injury. NanoScript is a nanoparticle that can turn on or off genes in cells that can control what the cells do. By carefully designing the NanoScript platform it can be tailored to turn various cell types into neurons which are the function unit of the central nervous system. This platform will be optimized and tested in three different cell lines chosen based on their clinical relevance. This proposal outlines two different therapeutic avenues. The first involves transplantation of cells, after being converted to neurons by NanoScript, into the damaged spinal cord of rats to reconnect the damage spinal cord. The second involves directly delivering NanoScript into the spinal cord to convert the local cells that invade the injury site into neurons to reestablish the neural connection. This will further research on cell transplantation into the spinal cord and can potentially lead to a clinically relevant therapeutic option.

2018 RESEARCH GRANT AWARDS - SPINAL CORD TECHNIQUES TRAINING TRAVEL GRANT RECIPIENTS:

Below are the project summaries of the Spinal Cord Techniques Training Travel grant recipients:

CSCR18TTT002 - \$4,000

Sara A. McEwan

Rutgers University

Cell Biology and Neuroscience

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According to the National Spinal Cord Injury Statistical Center, the incidence of spinal cord injury (SCI) in the United States is approximately 54 cases per million, with 17,500 new cases each year as of 2017, not including cases resulting in death at the scene of the accident. SCI can result in paralysis and degenerative neuronal disease, which is why understanding the molecular mechanisms and therapeutic approaches for SCI are of high relevance. For this reason, I developed a strong interest in studying traumatic neuronal injury and the resulting neurodegeneration.

Upon joining the Firestein laboratory, I contributed to a project involving the investigation of the role of cypin (cytosolic PSD-95 interactor), in traumatic brain injury (TBI) through the use of small molecule compounds. This project, conducted by a former graduate student, Dr. Przemyslaw Swiatkowski, involved the electrophysiological, survival, and behavioral effects of cypin modulation after traumatic brain injury. In brief, we found that activation of cypins activity leads to improved function, increased neuron survival, and improved neurobehavioral performance after TBI.

For my thesis research, I chose to translate this work into examining the role of cypin in spinal cord injury by altering its expression through overexpression and knockdown experiments. Cypin is a guanine deaminase that promotes dendritic branching and microtubule assembly. Our laboratory has published data supporting the idea that cypin plays a role in the recovery process after an in vitro glutamate-induced injury model of TBI. It is therefore of great value to assess the role of cypin after an in vitro culture and slice models of spinal cord injury. This project will directly investigate the neuroprotective potential of cypin by examining its contribution to SC neuronal survival, morphology, and electrophysiological function after glutamate-induced injury. I will test this hypothesis both in mixed spinal cord culture and organotypic spinal cord slice models of cypin knockdown or overexpression, examining the effect on both the structure and function of spinal cord neurons after injury.

2018 RESEARCH GRANT AWARDS - SPINAL CORD TECHNIQUES TRAINING TRAVEL GRANT RECIPIENTS:

This project will complement, but not replicate an ongoing NJCSCR-funded project in our lab. Dr. Firestein was awarded a grant from the NJCSCR in collaboration with Dr. Stella Elkabes (New Jersey Medical School-Rutgers: Newark) based on the hypothesis that activating the enzymatic activity of cypin with small molecules used in our lab TBI studies will improve motor and sensory neuron survival, electrophysiological function, and behavioral performance following SCI. This project is based on the hypothesis that activation of cypin will result in increased production of uric acid, a neuroprotective compound, which will ultimately result in recovery of function after in vitro and in vivo spinal cord injury. While I have begun training in cell and slice culture in addition to electrophysiology, I lack the knowledge and skills required to successfully perform SCI in vivo. I believe that granting me this training award will allow me to take the Spinal Cord Injury Research Methods Workshop at the W. M. Keck Center for Collaborative Neuroscience at Rutgers University and translate my acquired knowledge towards translating the results from my in vitro studies into an in vivo SCI model and enhancing knowledge and skills for my thesis work and my goal of becoming an SCI researcher.

2018 RESEARCH GRANT AWARDS - SPINAL CORD TECHNIQUES TRAINING TRAVEL GRANT RECIPIENTS:

Below are the project summaries of the Spinal Cord Techniques Training Travel grant recipients:

CSCR18TTT003 - \$4,000

Anton Omelchenko

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My training goals include to learn the molecular techniques and injury model approaches utilized to research and discover novel molecular targets for the development of therapeutics that may ameliorate or prevent further cell damage after spinal cord injury. I plan to learn and understand the steps involved in the drug development pipeline, to be able to make significant contributions to therapeutic discovery. I would like to gain adequate understanding in experimental design to effectively investigate the molecular mechanisms behind secondary spinal cord injury in order to curtail preventable cell damage and to foster a cellular environment which promotes axonal regeneration.

I plan to attend the spinal cord injury techniques course to learn and better understand the injury model approaches utilized to develop therapeutics for spinal cord injury. As my current work focuses on discovering potential pharmacological agents to ameliorate the secondary damage associated with spinal cord injury and traumatic brain injury in vitro, I would like to continue to test potential therapeutics utilizing an in vivo spinal cord injury model. While discovering possible molecular targets and potential therapeutics in vitro is important and necessary, extensive testing must be performed with in vivo animal models of any pathological condition or disease before any potential therapeutic progresses further down the drug development pipeline. I expect that taking the spinal cord injury techniques course will significantly expand my current set of scientific skills, and provide me with the opportunity to further investigate the neuroprotective potential of pharmacological agents that I find efficacious in my in vitro studies.

As a student in the Firestein laboratory, my work has primarily focused on the development of a microfabricated device that can be used to model Traumatic Brain Injury (TBI) in vitro and to screen pharmacological treatments for injury in a high-throughput manner. As mitochondrial dysfunction has been previously implicated in the excitotoxicity and cellular damage that occurs during TBI secondary injury, we hypothesized that targeting mitochondrial dysfunction after stretch/strain injury (diffuse axonal injury) will promote axonal survival and diminish secondary

2018 RESEARCH GRANT AWARDS - SPINAL CORD TECHNIQUES TRAINING TRAVEL GRANT RECIPIENTS:

damage following trauma. The device is constructed using polydimethylsiloxane (PDMS), a silicon-based polymer, and consists of two compartments connected by microfluidic channels. Two separate hippocampal organotypic rat brain slices are cultured within the two compartments, and the two slices create axonal connections through the microfluidic channels. In order to model TBI, uniaxial strain is applied beneath the axons spanning through the microchannels, and mitochondrial function is examined in the axons of neurons with fluorescence microscopy and label-free optical scatter imaging. Potential therapeutics are applied at different time points in the time-course of injury, and axonal viability and mitochondrial dynamics are subsequently measured. Our current findings suggest that application of a low-strain injury induces significant mitochondrial fragmentation (fission), and that the severity of fragmentation may play a role in axonal viability outcome. Additionally, our findings suggest that mitochondrial localization may play a role in axonal bead formation and that directly inhibiting mitochondrial fission may lead to significantly greater axonal beading and attenuate axonal viability following stretch/strain injury. Lastly, we are currently working on expanding the capabilities of our device to house several organotypic slice pairs from different animals in order to expand the throughput capacity of our system. Overall, my work on this project has greatly shaped my ongoing interest in the discovery of novel targets to aid in the development of therapeutics aimed to treat and prevent secondary damage following neural trauma.

In the future, I would like to pursue an academic position as a Principal Investigator in a research university setting. I plan to continue to conduct research on novel molecular targets for therapeutics aimed to treat and prevent secondary injury following spinal cord injury and traumatic brain injury, and I believe that taking the techniques training course will provide me with the skills and opportunities that will significantly facilitate my ability to achieve my goals.

ATTACHMENT A SPINAL CORD RESEARCH ACT

ATTACHMENT A

Spinal Cord Research Act

CHAPTER 201

An Act establishing a New Jersey Commission on Spinal Cord Research, supplementing Title 52 of the Revised Statutes and amending R.S.39:5-41.

Be It Enacted *by the Senate and General Assembly of the State of New Jersey:*

C.52:93E-1 Short title.

1. This act shall be known and may be cited as the “Spinal Cord Research Act.”

C.52:93E-2 Definitions relative to spinal cord research.

2. As used in this act:

a. “Approved research project” means a peer reviewed scientific research project, which is approved by the commission and which focuses on the treatment and cure of spinal cord injuries and diseases that damage the spinal cord.

b. “Commission” means the New Jersey Commission on Spinal Cord Research established pursuant to this act.

c. “Institutional support services” means all services, facilities, equipment, personnel and expenditures associated with the creation and maintenance of approved research projects.

d. “Qualifying research institution” means the University of Medicine and Dentistry of New Jersey; Rutgers, The State University; Princeton University; the Kessler Medical Rehabilitation Research and Education Corporation; the Coriell Institute for Medical Research; and any other research institution in the State approved by the commission.

C.52:93E-3 New Jersey Commission on spinal Cord Research.

3. a. There is established in the Executive Branch of the State government, the New Jersey Commission on Spinal Cord Research. For the purposes of complying with the provisions of Article V, Section IV, paragraph 1 of the New Jersey Constitution, the commission is allocated within the Department of Health and Senior Services, but notwithstanding that allocation, the

ATTACHMENT A SPINAL CORD RESEARCH ACT

commission shall be independent of any supervision or control by the department or by any board or officer thereof.

b. The commission shall consist of 11 members, including the Commissioner of Health and Senior Services, or his designee, who shall serve ex officio; one representative of the University of Medicine and Dentistry of New Jersey; one representative of Rutgers, The State University; one representative of the federally designated Spinal Cord Injury Model System; one representative from the American Paralysis Association; and six public members who are residents of the State knowledgeable about spinal cord injuries and who include at least one physician licensed in this State and at least one person with a spinal cord injury. The members shall be appointed by the Governor with the advice and consent of the Senate.

c. The term of office of each appointed member shall be three years, but of the members first appointed, three shall be appointed for a term of one year, four for terms of two years, and three for terms of three years. All vacancies shall be filled for the balances of the unexpired terms in the same manner as the original appointments. Appointed members are eligible for reappointment upon the expiration of their terms. A member shall continue to serve upon the expiration of his term until a successor is appointed.

The members of the commission shall not receive compensation for their services, but shall be reimbursed for the actual and necessary expenses incurred in the performance of their duties as members of the commission.

C.52:93E-4 Responsibilities of commission.

4. The commission shall:

a. Review and authorize approved research projects, for which purpose the commission may establish an independent scientific advisory panel composed of scientists and clinicians who are not members of the commission to review proposals submitted to the commission and make funding recommendations to the commission;

b. Apportion all available funds to qualifying research institutions to finance approved research projects and necessary institutional support services;

c. Ensure that funds so apportioned to approved research projects are not diverted to any other use;

d. Take steps necessary to encourage the development within the State of spinal cord research projects;

ATTACHMENT A SPINAL CORD RESEARCH ACT

- e. Compile a directory of all spinal cord research projects being conducted in the State; and
- f. Provide the Governor and the Legislature with a report by January 30 of each year describing the status of the commission's activities and the results of its funded research efforts.

C.52:93E-5 Authority of commission.

5. The commission is authorized to:

- a. Adopt rules and regulations concerning the operation of the commission, the functions and responsibilities of its officers and employees and other matters as may be necessary to carry out the purposes of this act;
- b. Maintain offices at such places within the State as it may designate;
- c. Employ an executive director and other personnel as may be necessary, whose employment shall be in the unclassified service of the State, except that employees performing stenographic or clerical duties shall be appointed pursuant to Title 11A (Civil Service) of the New Jersey Statutes;
- d. Design a fair and equitable system for the solicitation, evaluation and approval of proposals for spinal cord research projects;
- e. Apply for and accept any grant of money from the federal government, which may be available for programs relating to research on the spinal cord;
- f. Enter into contracts with individuals, organizations and institutions necessary or incidental to the performance of its duties and the execution of its powers under this act; and
- g. Accept gifts, grants and bequests of funds from individuals, foundations, corporations, governmental agencies and other organizations and institutions.

C.52:93E-6 Election, duties of officers.

6. The commission shall annually elect a chairman and a vice-chairman from among its members. The chairman shall be the chief executive officer of the commission, shall preside at all meetings of the commission and shall perform other duties that the commission may prescribe.

The executive director shall serve as secretary to the commission and shall carry out its policies under the direction of the chairman.

ATTACHMENT A SPINAL CORD RESEARCH ACT

C.52:9E-7 Direct application for funds permitted.

7. Nothing in this act shall preclude a qualifying research institution or any other research facility in the State from directly applying for or receiving funds from any public or private agency to conduct spinal cord research.

C.52:93E-8 Establishment, maintenance of central registry.

8. a. The commission shall establish and maintain, in conjunction with the Department of Health and Senior Services, a central registry of persons who sustain spinal cord injuries other than through disease, whether or not the injury results in a permanent disability, in order to provide a database that indicates the incidence and prevalence of spinal cord injuries and which will serve as a resource for research, evaluation and information on spinal cord injuries and available services.

b. The commission shall require the reporting of all cases of spinal cord injuries, except those caused through disease, and the submission of specified additional information on reported cases as it deems necessary and appropriate.

The commission shall, by regulation, specify the health care facilities and providers required to make the report of a spinal cord injury to the registry, information that shall be included in the report to the registry, the method for making the report and the time period in which the report shall be made.

c. The reports made pursuant to this section are to be used only by the commission and the Department of Health and Senior Services and such other agencies as may be designated by the commission or the department and shall not otherwise be divulged or made public so as to disclose the identity of any person to whom they relate; and to that end, the reports shall not be included under materials available to public inspection pursuant to P.L.1963, c.73 (C.47:1A-1 et seq.).

d. No individual or organization providing information to the commission in accordance with this section shall be deemed to be, or held liable for, divulging confidential information. Nothing in this section shall be construed to compel any individual to submit to medical, commission or department examination or supervision.

e. A health care facility or health care provider who is required to report a spinal cord injury to the commission that fails to comply with the provisions of this section shall be liable to a penalty of up to \$100 per unreported spinal cord injury case. A penalty sued for under the provisions of this section shall be recovered by and in the name of the commission and shall be deposited in the "New Jersey Spinal Cord Research Fund" established pursuant to this act.

ATTACHMENT A SPINAL CORD RESEARCH ACT

C.52:93E-9 “New Jersey Spinal Cord Research Fund.”

9. a. There is established in the Department of the Treasury a nonlapsing revolving fund to be known as the “New Jersey Spinal Cord Research Fund.” This fund shall be the repository for moneys provided pursuant to subsection e. of R.S.39:5-41. Moneys deposited in the fund, and any interest earned thereon, shall be used exclusively for the purpose of making grants for approved spinal cord research projects at qualified research institutions.

b. Any costs incurred by the department in the collection or administration of the fund may be deducted from the funds deposited therein, as determined by the Director of the Division of Budget and Accounting.

10. R.S.39:5-41 is amended to read as follows:

Fines, penalties; forfeitures, disposition of; exceptions.

39:5-41. a. All fines, penalties and forfeitures imposed and collected under authority of law for any violations of R.S.39:4-63 and R.S.39:4-64 shall be forwarded by the judge to whom the same have been paid to the proper financial officer of a county, if the violation occurred within the jurisdiction of that county’s central municipal court, established pursuant to N.J.S.2B:12-1 et seq. or the municipality wherein the violation occurred, to be used by the county or municipality to help finance litter control activities in addition to or supplementing existing litter pickup and removal activities in the municipality.

b. Except as otherwise provided by subsection a. of this section, all fines, penalties and forfeitures imposed and collected under authority of law for any violations of the provisions of this Title, other than those violations in which the complaining witness is the director, a member of his staff, a member of the State Police, a member of a county police department and force or a county park police system in a county that has established a central municipal court, an inspector of the Board of Public Utilities, or a law enforcement officer of any other State agency, shall be forwarded by the judge to whom the same have been paid as follows: one-half of the total amount collected to the financial officer, as designated by the local governing body, of the respective municipalities wherein the violations occurred, to be used by the municipality for general municipal use and to defray the cost of operating the municipal court; and one-half of the total amount collected to the proper financial officer of the county wherein they were collected, to be used by the county as a fund for the construction, reconstruction, maintenance and repair of roads and bridges, snow removal, the acquisition and purchase of rights-of-way, and the purchase, replacement and repair of equipment for use on said roads and bridges therein. Up to 25% of the money received by a municipality pursuant to this subsection, but not more than the actual amount budgeted for the municipal court, whichever is less, may be used to upgrade case processing.

ATTACHMENT A SPINAL CORD RESEARCH ACT

All fines, penalties and forfeitures imposed and collected under authority of law for any violations of the provisions of this Title, in which the complaining witness is a member of a county police department and force or a county park police system in a county that has established a central municipal court, shall be forwarded by the judge to whom the same have been paid to the financial officer, designated by the governing body of the county, for all violations occurring within the jurisdiction of that court, to be used for general county use and to defray the cost of operating the central municipal court.

Whenever any county has deposited moneys collected pursuant to this section in a special trust fund in lieu of expending the same for the purposes authorized by this section, it may withdraw from said special trust fund in any year an amount which is not in excess of the amount expended by the county over the immediately preceding three-year period from general county revenues for said purposes. Such moneys withdrawn from the trust fund shall be accounted for and used as are other general county revenues.

c. (Deleted by amendment, P.L.1993, c.293.)

d. Notwithstanding the provisions of subsections a. and b. of this section, \$1.00 shall be added to the amount of each fine and penalty imposed and collected under authority of any law for any violation of the provisions of Title 39 of the Revised Statutes or any other motor vehicle or traffic violation in this State and shall be forwarded by the person to whom the same are paid to the State Treasurer. In addition, upon the forfeiture of bail, \$1.00 of that forfeiture shall be forwarded to the State Treasurer. The State Treasurer shall annually deposit those moneys so forwarded in the "Body Armor Replacement" fund established pursuant to section 1 of P.L.1997, c.177 (C.52:17B-4.4). Beginning in the fiscal year next following the effective date of this act, the State Treasurer annually shall allocate from those moneys so forwarded an amount not to exceed \$400,000 to the Department of Personnel to be expended exclusively for the purposes of funding the operation of the "Law Enforcement Officer Crisis Intervention Services" telephone hotline established and maintained under the provisions of P.L.1998, c.149 (C.11A:2-25 et al.).

e. Notwithstanding the provisions of subsections a. and b. of this section, \$1 shall be added to the amount of each fine and penalty imposed and collected under authority of any law for any violation of the provisions of Title 39 of the Revised Statutes or any other motor vehicle or traffic violation in this State and shall be forwarded by the person to whom the same are paid to the State Treasurer. The State Treasurer shall annually deposit those moneys so forwarded in the "New Jersey Spinal Cord Research Fund" established pursuant to section 9 of P.L.1999, c.201 (C.52:9E-9). In order to comply with the provisions of Article VIII, Section II, paragraph 5 of the State Constitution, a municipal or county agency which forwards moneys to the State Treasurer pursuant to this subsection may retain an amount equal to 2% of the moneys which it collects pursuant to this subsection as compensation for its administrative costs associated with implementing the provisions of this subsection.

ATTACHMENT A SPINAL CORD RESEARCH ACT

C.52:93E-10 Rules, regulations pertinent to spinal cord research.

11. The commission shall adopt such regulations pursuant to the “Administrative Procedure Act,” P.L.1968, c.410 (C.52:14B-1 et seq.) as are necessary to carry out the provisions of this act.

12. This act shall take effect on the 90th day following enactment.

Approved September 13, 1999.