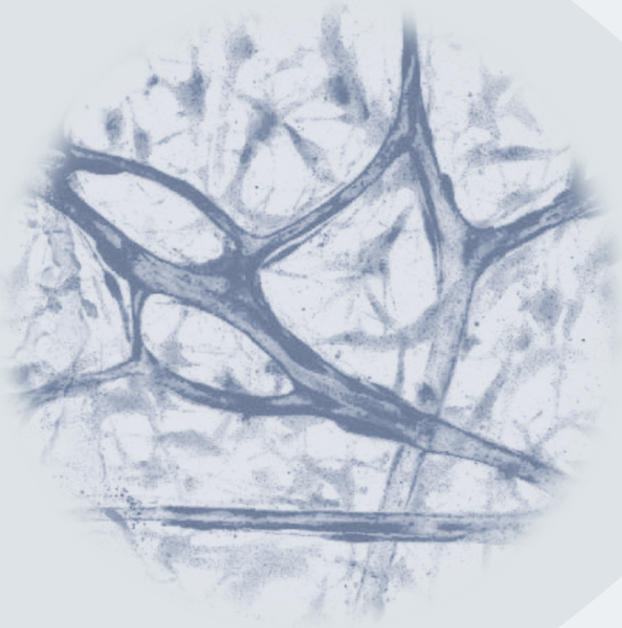
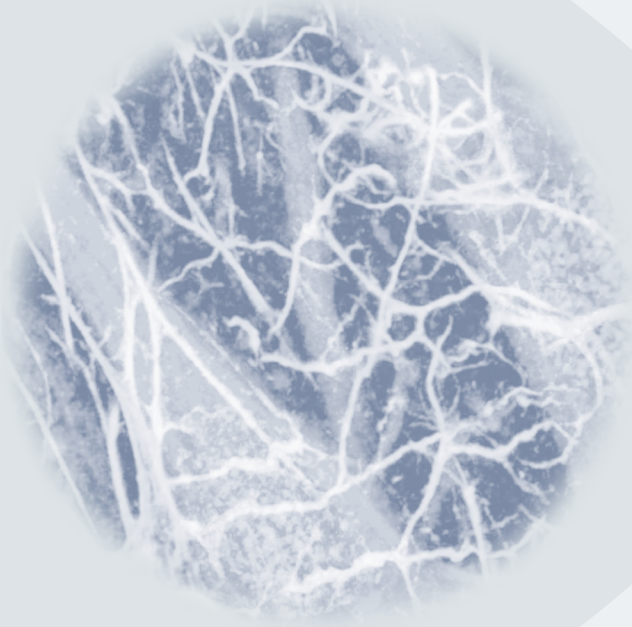


Report on The Empire State Stem Cell Program (NYSTEM)



amsny

Educate · Advocate · Collaborate

Associated Medical Schools of New York

April 2012

The Associated Medical Schools of New York (AMSNY) is a consortium of the 16 public and private medical schools in New York State. AMSNY works in partnership with its members to improve health care through education, advocacy and collaboration. AMSNY's focus areas include, but are not limited to: faculty development, diversity/inclusion of medical students and medical school faculty, and development of best practices around medical education, educational informatics, and global health. In addition, AMSNY works with its members to promote research initiatives that aim to improve health care outcomes.

AMSNY MEMBER INSTITUTIONS

Albany Medical College

Albert Einstein College of Medicine of Yeshiva University

Columbia University College of Physicians & Surgeons

Hofstra North Shore-LIJ School of Medicine at Hofstra University

Mount Sinai School of Medicine

New York College of Osteopathic Medicine

New York Medical College

New York University School of Medicine

Sophie Davis School of Biomedical Education at City College of New York

State University of New York Downstate Medical Center

State University of New York Upstate Medical University

Stony Brook School of Medicine

Touro College of Osteopathic Medicine

University at Buffalo State University of New York School of Medicine and Biomedical Sciences

University of Rochester School of Medicine and Dentistry

Weill Cornell Medical College

Associated Medical Schools of New York
1270 Avenue of the Americas, Suite 606
New York, NY 10020
Phone: 212-218-4610 • Fax: 212-218-4278
E-mail: info@amsny.org • Web: www.amsny.org

Front cover photos courtesy of University of Rochester Medical Center (Nancy Ann Oberheim, Takahiro Takano) and Columbia University College of Physicians and Surgeons (Gordana Vunjak-Novakovic)

Acknowledgements

The 2012 Report on the Empire State Stem Cell Program is an update of the 2010 report that described the development and impact of New York State's stem cell program. This report provides current data on the number of jobs created and maintained by NYSTEM funding at New York State's medical schools and outlines recent advances in research that are a direct result of the NYSTEM grants.

The report was developed with the help of many people. The publication was produced under the direction of Jo Wiederhorn, Crystal Mainiero and Samuel Mott. We owe special thanks to the efforts of the AMSNY Government Relations Committee who helped facilitate discussions and information gathering from various departments within their respective institutions. In addition, we are grateful for the careful editing of Janet Silver and Jonathan Teyan.

We welcome comments and suggestions for future editions of this report.

Please direct your correspondence to:
Crystal Mainiero, Chief Operating Officer
Associated Medical Schools of New York (AMSNY)
crystalmainiero@amsny.org

Table of Contents

Introduction

Over the past several years, New York State has experienced a major economic downturn as it struggles to weather the local, national and global economic crises. This type of economic situation can lead to a potential loss of federal aid in the foreseeable future. As a result, all state-funded programs are at risk. Given New York's current economic climate, it is important to continue to fund state programs that provide significant and demonstrable economic and social returns.

A prime example is the Empire State Stem Cell Program (NYSTEM). In 2007, New York State committed $600 million over eleven years to NYSTEM, making it the largest government-financed stem cell program in the country, outside of California's. The state's objective was to sponsor a strong research community that could investigate the potential of stem cell science to alleviate disease and improve human health. Of nearly equal importance was the goal of economic development – the investment in research and facilities that would create jobs, both directly and indirectly, and fuel the local economy. The Empire State Stem Cell Board was created and charged with making grants for basic, applied, translational and other research and development activities to advance stem cell research throughout the state. After the first year, which jump-started the program with $100 million, $50 million was to be allocated to the program in subsequent years. This plan was fully implemented until FY 2010-11 when the NYSTEM budget was decreased to $44.8 million.

New York's funding commitment is critical to the state's stem cell research and patient communities given its unique nature. NYSTEM funds early stage projects that have had difficulty accessing other funding sources like the National Institutes of Health (NIH). NYSTEM also is distinctive among other research grants in that it provides funding for capital projects and equipment, allowing institutions to develop or expand their stem cell research infrastructure. In 2001, the federal government severely limited federal financing for embryonic stem cell research, a move that set off intense competition among states to create publicly funded stem cell programs. Although the Obama administration has expanded the number of stem cell lines available for use in NIH funded research from 21 to 136 lines[1], certain funding limitations still remain. The NYSTEM program has made it possible for stem cell research to thrive in New York State.

[1] U.S. National Institutes of Health. NIH Human Embryonic Stem Cell Registry. Available at http://grants.nih.gov/stem_cells/registry/current.htm. Accessed November 22, 2011.

Measure of NYSTEM's Success

Since awarding its first grant in early 2008, NYSTEM has allocated nearly $223 million through a competitive, peer-reviewed grant process. To date, important progress has been made as scientists use NYSTEM funding to further unlock the mysteries of human biology and make progress in treatments and develop potential cures to many of the diseases that affect so many Americans. The program has also stimulated New York State research institutions to make major investments in support of stem cell research, which in turn has improved their ability to win NIH grants and attract private sector and philanthropic funding.

NYSTEM's success can be outlined in the following areas:

- Economic impact
    - Job creation
    - Leveraging of funds to obtain grants from federal and philanthropic sources
    - Cost-savings
- Scientific innovation and medical advances
- Education and training of a future biomedical research workforce
- Enhanced cross-institutional collaboration and public/private partnerships

Economic Impact

New York's investment in stem cell research creates and sustains jobs while seeking to improve the population's health. New York's medical schools have been awarded over 62 percent, or $137.5 million, of NYSTEM funding to date[2]. The remainder has been awarded to other health care and research institutions including the Regenerative Research Foundation and Cold Spring Harbor Laboratory. Because of New York's funding commitment, the state's biomedical research and commercial sectors have grown and New York has achieved a scientific and economic advantage over states that do not have dedicated stem cell programs. Even in states that do have programs, NYSTEM has proven to be a great example of a simple, well run and effective program. In addition, the state grants have resulted in a multiplier effect, as grant recipients have been able to raise additional monies either through federal grants or private donations to further enhance the impact of the initial investment.

New York's continued investment in stem cell research will generate significant benefits to the state's economy. NYSTEM's economic impact can be broken down into three different segments: *job creation, leveraging of funds and cost-savings.*

Job Creation

New York State is home to one of the strongest biomedical research communities in the world, with sixteen medical schools, and approximately 100 teaching hospitals and other top quality research institutions. Leading scientists and medical professionals from across the country are coming to New York because they are able to conduct cutting-edge research in the state. In doing so, these scientists are often bringing with them their National Institutes of Health (NIH) grants and post-doctoral students. Furthermore, medical schools and research laboratories are hiring new researchers to complement their stem cell programs. The growing research infrastructure brings increased revenue for research facilities and staff to train new graduate students, develop new drug therapies, and spin off clinical businesses throughout the region.

As a result of NYSTEM funding received by the medical schools, approximately 404 jobs in stem cell research labs have been identified as being created and/or maintained since 2008.

- At the *Albert Einstein College of Medicine*, 12 new researchers have been hired.

[2] Although NYS medical schools have been awarded a total of $137.5m in NYSTEM grants, only partial funding has been received by the medical schools to date.

- At *Columbia University Medical Center*, an estimated 100 positions have been filled and/or maintained with NYSTEM funding.

- The *Mount Sinai School of Medicine* supports up to 73 research and related jobs through NYSTEM funding. With continued support through NYSTEM and other philanthropic sources, Mount Sinai anticipates they will double the number of new jobs created over the next five years.

- At *New York Medical College*, three post-doctorate fellows and two new faculty members were hired.

- NYSTEM funding to *New York University School of Medicine* supports approximately 86 FTEs within the Kimmel Center for Stem Cell Biology. If NYSTEM funding were to be eliminated, seven laboratories at NYU would no longer conduct stem cell research and a total of 27 projects would cease.

- The *University at Buffalo SUNY School of Medicine and Biomedical Sciences* estimates 30 FTE's are covered through NYSTEM funding. This includes faculty, graduate students, post-doctorates, and technicians.

- The *University of Rochester* estimates 50 FTEs have been created or maintained with state funding received to date.

- *Weill Cornell Medical College* estimates 48 FTEs are supported through NYSTEM grants.

The dollars that New York's stem cell program awards for research provide real and direct economic benefits to the community, including increased employment, growth opportunities for universities, medical centers, and local businesses. Moreover, these jobs and the construction or renovation of stem cell lab space has led to a multiplier effect creating hundreds of additional construction jobs as a result of the initial NYSTEM investment.

Leveraging of NYSTEM Grant Funds

Researchers at the institutions that have received NYSTEM funding have been able to leverage their awards to receive additional funding from federal and philanthropic sources. This leveraged funding includes both direct follow-up awards and awards for other stem cell research projects by NYSTEM funded scientists.

Some examples include:

- In March of 2010, NYSTEM funding was instrumental in assisting *Albert Einstein College of Medicine* in obtaining $10 million from the National Institutes of Health (NIH), issued under the American Recovery and Reinvestment Act (ARRA), to expand its stem cell research capabilities. These funds are being used to create new laboratories in order to expand its already substantial cohort of stem cell investigators.

- *Columbia University College of Physicians & Surgeons* estimates that funding for stem cell research from federal sources has increased roughly four times since NYSTEM began awarding grants in 2008, and within the same time period by about six times from other private/corporate sources..

- The *Mount Sinai School of Medicine* was also able to secure ARRA federal stimulus funding after receiving state funding for a shared facilities grant. In April 2010, the National Center for Research Resources, part of the National Institutes of Health (NIH), awarded nearly $10 million to Mount Sinai Medical Center to support the expansion, improvement, and consolidation of space for laboratories at Mount Sinai School of Medicine.

- The state's stem cell investment also leverages institutional support. At *Stony Brook University Medical Center*, NYSTEM funding spurred institutional support for renovations, faculty costs and new hires.

- At the *University of Rochester*, data that resulted from NYSTEM funded research at the Cardiovascular Research Institute was critical in obtaining a health-related research and development grant from NIH for $1,543,500 in order to study the role of immune response in vascular dysfunction in hypertension. Additionally, data developed from two NYSTEM grants at the Department of Orthopedics were instrumental in a grant award of $537,320 from the NIH for studies on skeletal repair and regeneration. Overall, the University's stem cell labs have direct cost commitments of more than $80 million.

- At *Weill Cornell Medical College*, the Ansary Institute takes a collaborative approach to stem cell research by bringing together scientists from across a wide spectrum of biomedical research. The Institute was established in 2004 with a generous gift from Mr. Hushang Ansary. Since then, the Institute has garnered approximately $26 million in external funding, including support from the Starr Foundation Tri-Institutional Stem Cell Initiative and NYSTEM.

If NYSTEM funding were to cease, the risk of losing stem cell researchers to other institutions outside of New York State would increase.

Cost-savings

As research advances to the stage of successful therapies, New York is positioned to realize billions of dollars in reduced health care costs. In New York, more than $94 billion is spent every year on health care – with taxpayers assuming $35 billion of the total cost.[3] A significant portion is spent treating individuals with chronic conditions, many of whom could benefit from stem cell research. In total, these diseases account for 73 percent of deaths in New York and 70 percent of total medical costs. Given the potential of stem cell research, New York could realize significant cost savings in future years.

[3] See A Scientific, Policy and Economic Analysis: New York and Stem Cell Research. University of Rochester.

Scientific Innovation and Medical Advances

Stem cells are self-renewing and have the ability to develop or generate into other types of cells. Given their unique capacity, stem cells are at the core of developmental biology and clinical applications. Scientists speculate that in the near future, stem cells may be used to replace or repair damaged cells and have the potential to drastically change the treatment of conditions like Alzheimer's disease, amyotrophic lateral sclerosis (i.e. ALS or Lou Gehrig's disease), burns, cancers, spinal cord injury, Parkinson's disease, juvenile diabetes and other conditions, thus bringing hope to millions of people suffering from a range of debilitating diseases. Stem cells are also a powerful research tool that will allow scientists to recreate and study diseases in a way that was never before possible, thus leading to better prevention strategies, treatments, and even cures.

NYSTEM funded stem cell research projects being conducted at New York State's medical schools and research institutions include:

- At the *Albert Einstein College of Medicine*, researchers are working to treat and cure diseases ranging from cancer and anemia to heart and liver diseases, obesity, and brain disorders. Einstein scientists are doing some highly advanced work on blood stem cell function and differentiation. Researchers are also replicating liver cells that could reduce the need for liver transplants using live donors and cadavers, resources that are in chronically short supply. Recognizing the importance of stem cell research for the future, Einstein has opened a new $25 million institute for stem cell and regenerative medicine research funded by philanthropy.

- At *Columbia University Medical Center*, faculty members are developing human motor neurons from skin fibroblasts using a technique that changes fibroblasts to pluripotent stem-like cells. Pluripotent cells have the ability to become nearly any type of cell in the body. In the past year, stem cell work conducted by researchers at the Columbia Stem Cell Initiative has resulted in several important discoveries. Among these breakthroughs is the identification of transcriptional networks that underlie the mesenchymal transformation of brain tumors. Investigators also demonstrated the ability of a novel stem cell type, called XEN, to contribute to cells within the mouse embryo, suggesting their potential utility for new approaches in regenerative medicine that do not require the use of embryonic stem cells.

- Through NYSTEM funding, researchers at the *Mount Sinai School of Medicine* discovered a method to transform human skin cells into stem cells and turned differentiated human stem cells into heart cells. These discoveries will enable deeper understanding of how heart disease develops and allows for initial testing of new treatments on stem cells before being used on human subjects. Other research programs focus on transforming skin cells from patients with schizophrenia, autism, and Alzheimer's disease into brain cells in order to study, in the laboratory, the abnormalities in these cells that lead to these crippling diseases.

- At the *New York University College of Dentistry*, a dental research team is studying the potential use of stem cells in regenerating facial muscles to enable people with traumatic injuries to speak, eat and smile normally again. The team plans to extract a small number of stem cells from the facial muscles of a pig, grow the cells into facial muscle on a tissue scaffold to develop a prosthesis, and transplant the prosthesis onto the pig's face to repair damaged muscle. Pigs are used for the study because their extracellular matrix is similar to that of humans, and because successfully transplanting the stem cells in a large animal model would pave the way for clinical trials on humans.

- At *New York University School of Medicine*, researchers are actively creating therapies for brain degeneration. In addition, NYU is utilizing NYSTEM funding on new targets for treating melanoma, neurological disorders, and potential paths that could lead to breakthroughs in the treatment of cancer, diabetes, and spinal cord injuries.

- At the *University at Buffalo SUNY School of Medicine and Biomedical Sciences* research falls under the developmental genomics theme of the UB2020 Strategic Strength in Molecular Recognition in Biological Systems and Bioinformatics (MRBS/BIO). This strategic strength is based on four thematic components: Molecular Signaling, DNA Replication and Repair, Developmental Genomics, and Chemical/Molecular Diversity. Developmental Genomics represents a group of thirteen investigators with interests in a number of biological systems including morphogenesis, cell differentiation and the control of cell division. These interests range from the exploration of fundamental biological processes such as early embryological development, through the bioengineering of specific organs and tissues, into the therapeutic application of stem cells for the treatment of neurodegenerative, cardiovascular and other diseases.

- The *University of Rochester*, home to several groundbreaking stem cell research programs in fields such as neurological diseases, cancer, bone repair, and musculoskeletal diseases, has been awarded more than $18 million in competitive grants through NYSTEM. In one important project, scientists at the University of Rochester Medical Center have developed a novel method to target and eradicate leukemia stem cells. This research has the potential to have significant impact on the treatment of patients with specific types of leukemia and will be useful in treating lymphoma and multiple myeloma.

- *Weill Cornell Medical College* scientists and physicians have recently identified new cancer stem cells. This discovery could signal a change in the direction of research on cancer stem cell biology and stimulate the search for new authentic cancer stem cell markers. In addition, Weill Cornell has utilized its NYSTEM funding to observe how stem cells replace cells that are damaged by disease and to understand the ability of stem cells in bone marrow to help heal wounds. One of the most recent awards went to Dr. Betsy Ross who will compare human and mouse embryonic stem cells at various stages of brain development to identify the point at which certain cells could be directed to regenerate brain tissue that has been damaged by diseases such as Alzheimer's.

Education and Training of the Future Stem Cell Research Workforce

Education and training are critically important to the future of stem cell research, as it represents a relatively new and expanding field that requires a highly specific knowledge base. NIH has not historically directed its resources to support stem cell training programs, making state funding essential to support the development of the future stem cell workforce. As a result of NYSTEM funding, several of the medical schools have developed training programs geared towards educating and training undergraduates, post-doctoral students and physicians in stem cell research:

- *Columbia University College of Physicians & Surgeons* offers a fellowship that aims to teach the next generation of scientists the tools of the trade for performing stem cell research. This program involves hands-on experience in stem cell labs, developing curricula with secondary school teachers and exposure to research carried out in the stem cell field.

- *New York University School of Medicine* received training grants from the National Cancer Institute and NYSTEM. Six slots are currently funded, including three postdoctoral and three graduate positions.

- With a grant from NYSTEM, *Stony Brook University Medical Center* developed a summer undergraduate program on stem cell education with a cohort of ten undergraduate students from across the nation in its first year. Students learn about stem cell research, work in labs on a specific stem cell project, and present their findings once the semester is over.

- The *University of Rochester School of Medicine and Dentistry* has developed a series of programs intended to help train the next generation of stem cell scientists. Using a multidisciplinary team of faculty, the University of Rochester has developed stem cell courses for undergraduate, non-biology majors. The courses, which are offered at the University of Rochester and at Monroe Community College, cover scientific concepts, as well as ethical, legal and social implications of stem cell science. In addition, they have used a NYSTEM training grant to provide training fellowships to four PhD students and two postdoctoral fellows working in six different stem cell laboratories.

Any further reductions in funding for the state's stem cell program will worsen the "brain drain" and diminish the work that has been done to expand the stem cell workforce pipeline and make the recruitment of talented junior scientists more difficult as the appearance of research and career advancement opportunities becomes uncertain or unstable in the state.

Enhanced Cross-institutional Collaboration

NYSTEM funding supports shared-use facilities to enhance stem cell research by maintaining quality control and laboratory supplies needed for stem cell experiments. NYSTEM's shared facility grants allow institutions to collaborate with one another and expand their research capabilities. Both technological resources and data can be shared, creating a strong and efficient research community. These shared-use facilities enable researchers to isolate, derive, and characterize stem cell lines. Cross-institutional collaborations pave the way for advancements in such industries as biotechnology and pharmaceuticals.

- *Albert Einstein College of Medicine's* partnership with Montefiore Medical Center offers the real prospect of bringing the products of Einstein stem cell research to patients in need of novel treatment approaches. The Montefiore-Einstein Transplant Center provides an interdisciplinary approach to patients, adult and pediatric, in need of organ transplant. High-throughput screening of human embryonic stem cells and induced pluripotent stem cells will enable discovery of factors required for regeneration of new heart, blood, lung, liver, pancreatic, kidney and brain cells. Not only cell replacement treatment, but also treatment of "regenerative factors," will likely represent the future in treating currently incurable diseases.

- For *Mount Sinai Medical Center*, $5 million went to a shared research facility that was initially funded by NIH. Mt. Sinai lost federal support for the facility's operations and was threatened with closure when the NYSTEM funding was awarded. The shared facility provides the opportunity for hands-on training and development of reagent materials. Approximately two dozen laboratories operate within the facility. Mt. Sinai works in collaboration with Memorial Sloan Kettering and other institutions (the NY Structural Biology Center at CUNY, for example). A majority of their projects focus on individual, early-stage research.

- *New York University School of Medicine's* Ribonucleic Acid Interference Core (RNAi) provides an integrated, state-of-the-art, high-throughput screening facility and is open to both internal and external users. It has facilitated numerous projects that would otherwise not be feasible under the purview of individual investigators. RNA interference is a process within living cells that moderates the activity of

their genes. The equipment contained within the RNAi Core facility is not found in a typical laboratory, and the staff has the expertise and specialized knowledge to train users on operation. In addition, the Core has developed tools and acquired software for data analysis, pathway analysis, and data visualization.

Five projects are taking place at the facility as a result of NYSTEM funding, and it is estimated that at least seven more will begin within the next six months. Drugs based on RNA interference are expected to be the next major class of human therapeutics.

- *Stony Brook University Medical Center* is poised to create a multi-user facility that will support 25 funded investigators and eight investigators seeking funding, as a single-point-of-entry resource to broadly provide scientific and educational support in stem cell processing, gene transfer and analysis.

- With a NYSTEM planning grant, *SUNY Downstate Medical Center* helped develop the SUNY EYE Institute that integrates the complementary strengths of the four SUNY medical centers and SUNY optometry. The SUNY EYE institute is a prime example of advancing the SUNY mission to increase opportunities for and support of inter-campus collaboration. As a result, the Institute received a U54 grant (an award for Interdisciplinary Research Consortia) from the NIH.

- The *University at Buffalo State University of New York (SUNY) School of Medicine and Biomedical Sciences* received $3.5 million from NYSTEM to establish a Western New York Stem Cell Culture and Analysis Center. These funds will be used to promote and facilitate research in the use of mouse and human embryonic, adult, induced pluripotent and cancer stem cells; not only at the University at Buffalo but at the partner institutions Roswell Park Cancer Institute and the Hauptman-Woodward Institute.

- With funding from NYSTEM, the *University of Rochester School of Medicine and Dentistry* is constructing a facility that meets current Good Manufacturing Processes (cGMP). cGMP are the procedures that biotech companies must follow to ensure that the products they produce meet Food and Drug Administration (FDA) standards. An FDA compliant facility is necessary to produce stem cells that are suitable for testing in humans. Meeting these standards requires highly specialized facilities. The Federal government does not provide any funding for these facilities therefore New York medical schools have been using NYSTEM shared facility grants for this purpose. Currently, there are no cGMP manufacturing facilities available for human stem cell products in upstate New York. This facility will be a regional

resource available to scientists throughout upstate New York and will accelerate the clinical application of stem cell research. A number of biotechnology companies have also formally expressed an interest in using the facility.

- *Weill Cornell Medical College* is part of the Ansary Stem Cell Institute, which takes a collaborative approach to stem cell research by tapping the expertise of scientists across a range of areas in biomedical research. The Institute has garnered approximately $26 million in external funding, including stem cell support from NYSTEM and the Tri-Institutional Stem Cell Initiative, which also includes the Rockefeller University and Memorial Sloan Kettering Cancer Center. One NYSTEM grant, for example, is being used to establish new, and maintain existing, core facilities at the Rockefeller University and Weill Cornell Medical College.

Conclusion

Cuts to NYSTEM will create a negative ripple effect on the economy

Last year's budget included $44.8 million for NYSTEM, down $5.2 million from the originally planned $50 million per year. Although New York is facing an upcoming deficit, any further reduction to New York's stem cell program will create a negative ripple effect on the state's economy and halt the advancements being made in medical research. NYSTEM, and the work that is funded through the program, are crucial components of New York's economic development strategy.

The dollars that New York's stem cell program sends out into communities provide real and direct economic benefits at the local level, including increased employment; growth opportunities for universities, medical centers, and local companies; and additional economic stimulus for the community. When state funding is cut, communities across the state suffer.

There is likewise significant risk that researchers in New York will be recruited away to institutions in other states – such as California, Connecticut, New Jersey, Illinois or Maryland - where they would have greater access to resources to support their research. The loss of these scientists would have a negative effect on the state's entire research community as research grants, junior scientists, biotech companies, and venture capital will similarly migrate to states that are perceived to be on the cutting edge of biomedical research. Even now, institutions in other states – and even other countries – are attempting to lure away New York's top scientists with the promise of public funding and a more welcoming regulatory climate for stem cell research. Any further reduction or elimination to the state's stem cell program will only worsen the "brain drain." New York would not only lose some of its top scientists to institutions in other states, but the future recruitment of talented junior scientists would become more difficult as the appearance of research and career advancement opportunities becomes uncertain or unstable. A loss of just a few of the state's stem cell scientists could lead to the loss of millions in federal funding.

If NYSTEM funding is lost, New York's medical schools and research institutions would be forced to end or significantly reduce existing research projects. As such, this would slow the progress in developing therapies that have the potential to drastically change the treatment of conditions like Alzheimer's disease, ALS, burns, cancers, heart disease, spinal cord injury, Parkinson's disease, juvenile diabetes and other conditions. Moreover, the new research facilities recently constructed would merely become "empty shells." At a time when grant

submissions to NYSTEM are at a historical high due to declining NIH funding, a loss of this funding stream could be devastating, particularly to junior investigators who lack substantial track records in obtaining NIH grants.

As illustrated, it is essential for New York State to preserve its commitment to stem cell research in order to sustain one of the strongest research communities in the world.

Key Definitions

Applied research: refers to scientific study and research that seeks to solve practical problems.

Basic research: refers to study and research on pure science that is meant to increase our scientific knowledge base.

Biomedical research: also known as medical research and encompasses basic, applied and translational research.

Brain drain: refers to the migration of highly educated people due to lack of opportunity, hazards or other external factors.

Cells: the basic structural and functional unit of all known living organisms.

Cell division: the process by which a parent cell divides into two or more daughter cells.

Developmental biology: the study of the process by which organisms grow and develop.

Differentiation: A process that occurs during development by which cells take on their specialized functions, such as the ability of a red blood cell to carry oxygen or a nerve cell to send an electrical signal.

Extracellular: in cell biology, means “outside the cell”

Fibroblasts: a type of cell that synthesizes the extracellular matrix and collagen, the structural framework for animal tissues, and plays a critical role in wound healing.

High-throughput screening: a method for scientific experimentation especially used in drug discovery and relevant fields of biology and chemistry.

Motor neurons: classically applies to neurons located in the central nervous system and directly or indirectly controls muscles.

Induced pluripotent stem cells: a type of pluripotent stem cell artificially derived from a non-pluripotent cell – typically an adult somatic cell

Mesenchymal stem cells: cells that can differentiate into a variety of cell types.

Morphogenesis: the biological process that causes an organism to develop its shape. It is one of three fundamental aspects of developmental biology, along with the control of cell growth and cellular differentiation.

Multiplier effect: in economics, this refers to the subsequent impact that direct expenditures have on the economy, as money is re-spent or circulated.

Pluripotent stem cells: Also known as embryonic stem cells – they have the ability to become any type of cell in the body (http://nyscf.org/about-stem-cells/stem-cells-101)

Reagent materials: a substance or compound that is added to a system in order to bring about a chemical reaction, or added to see if a reaction occurs.

Regeneration: the process of renewal, restoration, and growth.

Skin fibroblasts: cells which are responsible for generating connective tissue and allowing the skin to recover from injury.

Stem cell: Early stage cells that can become any type of cell in the body.

Translational research: a way of conducting scientific research to make the results of research applicable to the population under study.

Commonly Used Acronyms

AMSNY	Associated Medical Schools of New York
ARRA	American Recovery and Reinvestment Act of 2009
cGMP	Good Manufacturing Processes
FDA	Food and Drug Administration
hESC	Human Embryonic Stem Cell
NIH	National Institutes of Health
NYSTEM	New York State Stem Cell Science (refers to state grant program)

Additional Resources

New York State Stem Cell Science Program (http://stemcell.ny.gov/)

Stem Cells 101 – New York Stem Cell Foundation (http://nyscf.org/about-stem-cells/stem-cells-101)

Incorporated in 1967, the Associated Medical Schools of New York (AMSNY) is a consortium of the sixteen public and private medical schools in New York State. Working in partnership with its members, AMSNY's mission is to ensure the state's preeminence in the fields of medical education, research and patient care.

AMSNY facilitates collaboration and knowledge-sharing between the medical schools and coordinates an intensive statewide effort to develop a more diverse medical student population in order to address physician workforce issues within the state. It's focus areas include, but are not limited to: advocacy, faculty development, diversity/inclusion of the medical student and faculty populations, and promotion of research initiatives that aim to improve health care outcomes.