PRESS RELEASE

12 January 2009

S$40 MILLION COMMITTED BY NRF FOR FOUR RESEARCH PROJECTS ON "AGEING"

- *NRF accepts International Evaluation Panel's recommendations to fund four research projects dealing with various aspects of "Ageing"*

1 The National Research Foundation (NRF), on the recommendation of its International Evaluation Panel (IEP) for its Competitive Research Programme (CRP) Funding Scheme, announced today the first group of research proposals to be awarded grants under its inaugural scenario-based grant call. The CRP Funding Scheme funds up to S$10 million per proposal, over three to five years. It aims to identify future strategic research areas for Singapore by funding interdisciplinary research ideas at a level substantial enough to build strong capability. (See **ANNEX 1** for the list of IEP members and **ANNEX 2** for a description of the CRP Funding Scheme.)

2 The first Scenario-based CRP grant call was on "Ageing" (see **ANNEX 3** for more details). This opened on 13 June 2008 and received 48 preliminary proposals (or white papers) submitted by Singapore-based researchers from local universities, polytechnics, public research entities as well as private companies. Fourteen white papers were selected to be developed into full proposals. These full proposals were internationally peer-reviewed. The IEP met today to review the full proposals and recommended four for funding. NRF has accepted the panel's recommendation.

3 The four research programmes awarded funding by NRF are:

- Age-Related Neurodegenerative Disease – The Roles of microRNAs and Their Targets (PI: Stephen Cohen, Temasek Life Sciences Laboratory);
- An Integrated Approach to Overcome Sarcopenia and Frailty in Ageing Humans (PI: Ravi Kambadur, Nanyang Technological University);
- Autologous Cell Therapy for the Ageing Heart Using Reprogrammed Cells (PI: Winston Shim, National Heart Centre);
- Ischemic Stroke with a Focus on Intracranial Stenosis (PI: Peter Wong, National University of Singapore).

(See **ANNEX 4** for more details.)

4 Prof James Foley, Acting Chairman of the IEP and a member of NRF's Scientific Advisory Board, said: "The topic of "Ageing" for the first scenario-based CRP grant call is particularly relevant to Singapore, an affluent society with a steadily ageing population. With longer life span and higher expectations of quality of life, there are many opportunities for Singapore researchers to contribute to new discoveries in this important area. The panel was pleased with the quality of the research proposals selected for funding. These research projects will lead to a better understanding of the biological processes of ageing and may lead to future treatments of specific ailments related to ageing."

5 Dr Francis Yeoh, Chief Executive Officer, NRF, said: "The Scenario-based approach to research funding allows us to build up local R&D capability in specific areas of importance, rather than in specific technologies. It is a great opportunity for interdisciplinary research, where scientists with different expertise can bring their knowledge together to address areas of importance to our society. Research breakthroughs often occur at the interfaces between disciplines so I look forward to significant technical achievements from the supported projects."

6 Mr Gerard Ee, Chairman of the Council for Third Age, who was invited to evaluate the initial proposals, said: "Ageing is a concern in many developed societies, including Singapore. Socio-economic issues relating to ageing are being studied by the Council for Third Age here. I am happy that in addition to this effort, the government is also supporting science and technology research that will ultimately enhance the quality of life for senior citizens. I look forward to exciting results coming out of this initiative."

7 Dr Stephen Cohen from Temasek Life Sciences Laboratory, whose proposal entitled "Age-Related Neurodegenerative Disease – The Roles of microRNAs and Their Targets" was selected to receive funding, said: "We are pleased to be one of the recipients under the first Scenario-based CRP grant call. The work that we will be doing will improve our understanding of the basic cell biology of age-related neurodegenerative disease. This understanding may set the stage for new therapy in the future and help improve the quality of life for senior citizens. The team looks forward to this tremendous opportunity to conduct groundbreaking research on ageing."

8 CRP grant calls are launched twice a year. The fourth CRP grant call opened on 13 October 2008 for submission and received a total of 70 preliminary proposals by the close of the call on 16 November 2008. The call is currently in the evaluation stage and the final award will be announced in July 2009.

The National Research Foundation (NRF)

The National Research Foundation (NRF), set up on 1 January 2006, is a department under the Prime Minister's Office.

The NRF sets the national direction for research and development (R&D) by developing policies, plans and strategies for research, innovation and enterprise, funds strategic initiatives, builds up R&D capabilities and capacities through nurturing our own and attracting foreign talent, and coordinates the research agenda of different agencies to transform Singapore into a knowledge-intensive, innovative and entrepreneurial economy. It provides secretariat support to the Research, Innovation and Enterprise Council (RIEC), chaired by the Prime Minister. A five-year budget of S$5 billion has been allocated to the NRF in 2006 to achieve this mission.

The NRF aims to:

- Transform Singapore into a vibrant R&D hub that contributes towards a knowledge-intensive, innovative and entrepreneurial economy; and
- Make Singapore a talent magnet for scientific and innovation excellence.

For more information, please visit www.nrf.gov.sg.

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ANNEX 1

National Research Foundation
Competitive Research Programme Funding Scheme

International Evaluation Panel	
1.	**Prof James Foley (Acting Chairman)** Stephen Fleming Chair in Telecommunications and Professor, Interim Dean, College of Computing, Georgia Institute of Technology, USA (concurrently NRF Scientific Advisory Board Member)
2.	**Prof Dr Louis-François Pau** Professor, RSM Erasmus University, Netherlands and Copenhagen Business School, Denmark (concurrently NRF Scientific Advisory Board Member)
3.	**Dr Richard Roberts** Chief Scientific Officer, New England Biolabs, USA Nobel Laureate in Medicine (1993)
4.	**Mr Thomas Stagnaro** President and Chief Executive Officer, Americas Biotech Distributor, USA
5.	**Mr Peter Tan** Founder and General Partner, JP Asia Capital Partners, Singapore
6.	**Dr Richard Yen** Founder and Managing Director, Ednovation Pte Ltd, Singapore
7.	**Dr Hal Broderson** Founder and Managing Director, Rock Hill Ventures, USA
8.	**Dr Rita Colwell (Chairman)*** Distinguished University Professor, University of Maryland College Park and Johns Hopkins University Bloomberg School of Public Health, USA (concurrently NRF Scientific Advisory Board Member)

* Not present at this meeting.

ANNEX 2

The Competitive Research Programme Funding Scheme

The Competitive Research Programme (CRP) Funding Scheme complements the existing Strategic Research Programmes that have been identified top-down, by funding a broad base of research ideas, through a competitive bottom-up approach. This will help to identify new potential strategic research areas in which Singapore can invest to develop core capabilities for new industries of the future.

The CRP Funding Scheme will support R&D programmes, each comprising multiple related projects under a unifying theme. Each award is for a maximum of S$10 million per programme, over three to five years. There are expected to be two rounds of grant calls each year.

While the CRP Funding Scheme is open to all areas of science and technology, preference will be given to areas that fall outside of the focus of existing NRF Strategic Research Programmes, such as the Biomedical Sciences Translational and Clinical Research (BMS TCR), Environmental and Water Technologies (EWT), and Interactive and Digital Media (IDM).

Open to both public and private sector participants, the CRP Funding Scheme aims to encourage collaboration and partnerships between academia and industry. By funding at the programme level, a more coordinated and integrated support of high-impact inter-disciplinary research is possible as a larger budget can be allocated to fund a number of related projects to address a given problem.

The CRP Funding Scheme involves two types of calls: General and Scenario-based calls.

Overview of General and Scenario-based CRP

General CRP

The General CRP allows the Principal Investigators (PIs) to surface any new area of research with potential economic and societal benefits for Singapore through a bottom-up approach. Calls for the General CRP will be held annually. Each proposal should be submitted by a Lead PI, who is expected to be actively involved in the overall management of the programme and who will be accountable for the research and its deliverables.

CRP proposals should demonstrate the following:

i. High quality cutting-edge science;
ii. High likelihood of building up research infrastructure and capabilities in Singapore;
iii. Competent team consisting of individuals with credible track records;
iv. Excellent execution of individual projects which form a coherent programme; and
v. High potential to generate economic and societal benefits to Singapore by creating new industries or advancing existing industries.

Scenario-based CRP

The Scenario-based approach to identifying research programmes will complement the General CRP scheme. The Scenario-based CRP aims to support R&D programmes that are truly use-inspired and able to produce technical breakthroughs to big challenges and opportunities for Singapore.

In each Scenario-based call, NRF will articulate a future scenario that offers a major challenge or opportunity for Singapore. The research community will be invited to submit proposals for research programmes that will address key scientific and technological challenges presented by the given scenario.

In addition to the basic criteria for General CRP proposals, Scenario-based CRP proposals will also be evaluated on the following:

i. Extent to which the proposed R&D programme address the challenges or opportunities posed by the given scenario;
ii. Relevance and importance of the proposed R&D programme in terms of the economic, technological, social and environmental impact on Singapore; and
iii. Quality of the proposed R&D programme, compared to similar international efforts elsewhere.

Eligibility

Principal Investigators from all Singapore-based institutions of higher learning (IHLs), public sector agencies and research institutions, not-for-profit hospitals and research laboratories as well as companies and company-affiliated research laboratories, are eligible to apply. Support for private sector organisations which are based in Singapore would be provided on a co-funding basis.

Only research conducted in Singapore may be funded under the CRP.

R&D proposals already funded by other Singapore agencies would not be considered under the CRP.

Evaluation of Proposals

Both the General CRP and Scenario-based CRP involve a two-stage proposal submission process. Proposals submitted will be evaluated and shortlisted by a Local Evaluation Panel in the first stage. Shortlisted submissions will be asked to be developed into full proposals and sent for international peer review. The final evaluation and selection of projects to be awarded will be made by NRF on the recommendation of the CRP International Evaluation Panel (IEP).

Applications

Calls for both the General CRP and the Scenario-based CRP are publicised on NRF's Research, Innovation and Technology Administration (RITA) system. Interested applicants may find out more about the specific CRP calls that are open and submit their applications through the system.

For more information, please visit https://rita.nrf.gov.sg.

ANNEX 3

Singapore in 2020

Fast-forward to 2020…

With over 25% of its population above the age of 65 years old, Singapore, like many other developed countries around the world, has a distended grey population. The average lifespan has extended to 97 years old for women and 92 years old for men. Retirement age has correspondingly shifted upward to 75 years old. With this changing demographic brought about by advances in healthcare and falling birth rates, Singapore needs to address these challenges immediately through new technologies, relevant policies and programmes. To maintain a high quality of life, there would be increasing demand for assistive technology to help the aged stay in the workforce longer and lead independent lives; a healthcare system that relies on advanced home diagnostics and the need to cater to the special dietary preferences of the elderly; a requirement to put in place advanced geriatric health management systems in public hospitals, etc.

These challenges are likely to place additional pressures on the healthcare and social systems that may not be equipped to cope with this change. On the other hand, this new evolving demographic, could present a potentially large and affluent elderly consumer market with a technologically stimulating set of demands and needs. The opportunities that accompany this rise in ageing populations are tremendous as we seek to address their special array of needs.

Below are some examples of technologies for an ageing society:

- *Robotics technology, systems which consist of sensors, actuators and mechanisms, and, computers and their software, and incorporating information technology mature enough to be applied to several systems in our daily life. Some expectations: robots capable of lifting/carrying the elderly down staircases and corridors; robots that fold laundry and perform heavy-duty cleaning; and autonomous personal transportation robots capable of moving safely through busy intersections.*

- *Transforming the healthcare system. Developing technologies to keep people well and moving the health care from the hospital to the home. New computer-based technologies and innovations in sensors, software and wireless technologies that can allow such vital information as heart rate, respiratory rate, blood pressure and sleep patterns to be tracked remotely. Broadband Internet connectivity that allows the data to be shared real-time between seniors and healthcare professionals, as well as amongst family members and friends who deliver the majority of care to seniors.*
- *Bio-medical technologies that compensate for the impairments brought about through the ageing process, e.g. Prosthetic vision for persons whose ocular nerve has degenerated from ageing.*

- *Basic molecular mechanisms believed to underlie age-related dysfunction, with a focus on molecular studies, performed primarily in cell culture and*

model organisms. Genetic manipulations that affect the length and/or quality of life, as well as molecular and cellular mechanisms including mitochondrial dysfunction, cell senescence, changes in gene expression/signal transduction, DNA damage and repair, stress responses and protein homeostasis. Therapeutic application of stem cells in the emerging field of regenerative medicine with respect to degenerative diseases and functional declines that accompany ageing. The role of stem cells in preventing adverse age-related changes due to loss of specific cell types. Stem cells for the treatment of neurological disorders. Age-related cognitive decline.

- *Design for an ageing population. Crucial human factor design for enhancing productivity and operability of an ageing workforce. Energy balance indicators, such as "smart" clothing, household or office furnishings, that incorporate sensors, bar codes or other identifying technologies to calculate energy expenditure. Mathematical models for predicting interrelationships between energy balance and weight control in the aged.*

- *Studies translating what has been learned about ageing processes from the basic behavioral and social sciences to practical outcomes, including new technologies for the benefit of the aged or stimulate new "use-inspired" basic research in the behavioral and social sciences.*

- *Integrating Biology and Genetics with Behavioral and Social Sciences, Including Implications for Data Collection and Models of Analysis. E.g. Biomarkers can contribute to understanding how psychological, social and behavioral factors interact with biology to influence health outcomes at older ages.*

- *Bioengineering tools that integrate self-reported information with biologic and/or sensor measures of physical activity, diet/nutrition, and energy balance/obesity. (This would include tools that measure this integrated information in real-time.)*

- *Neuroeconomics applies psychological, economic, and neuroscience approaches to the study of motivated choice, economic decision making, and valuation or utility as typically understood in economic terms. E.g. age-related changes in judgment and decision making processes, reward processing, social behavior (including trust, cooperation, competition, intergenerational exchange), and the performance of individuals in market economies.*

The scenario-based CRP aims to inspire innovations for quality ageing that have a multi-disciplinary approach and coupled with a strong science base. As the ageing issue is complex and multi-facetted, it represents an opportunity for a holistic and integrative programme that combines biology, engineering, social behavioural sciences and economics. It is hoped that Singapore could become a world-class originator of innovative, aged-friendly technology, products and devices. The ageing issue requires the integration and strategic alignment of new technologies, personal responsibility and public policy.

ANNEX 4

Title: Age-Related Neurodegenerative Disease – The Roles of microRNAs and Their Targets

Age-related neurodegeneration is a major factor that impairs quality of life in the elderly. The potential for innovative approaches to treating this family of diseases lies in better understanding the causes of age related impairment of nerve cell function in the brain. Recent studies have implicated microRNAs in neurodegeneration. As the name suggests, microRNAs are a class of small RNA molecules. Each microRNA has the potential to control the expression of hundreds of protein-coding genes, and thus can have a profound impact on the function of the cells in which they are expressed. Work from Dr Stephen Cohen's lab over the past several years has focused on understanding biological functions of microRNAs. They combine conventional genetic analysis to understand the biological process affected by the microRNA, with computational and biochemical tools to identify the target genes that microRNAs regulate. microRNA genes are numerous and are involved in diverse biological processes, including age-related neurodegenration. This project aims to make use of the sophisticated genetic and neurobiological tools available in Drosophila to systematically study the roles of microRNAs in neurodegeneration. Understanding the molecular and cellular basis for these defects in these should provide new insights into cellular basis of neurodegenerative disease.

Dr Stephen COHEN
Executive Director
Temasek Life Sciences Laboratory

Adjunct Professor
Department of Biological Sciences
National University of Singapore

Dr Stephen Cohen studied Zoology at University of Toronto. His PhD training was at Princeton University and he did post-doctoral work at MIT and at the Max Planck Institute in Tübigen Germany, where he began to work on Drosophila developmental genetics. He was a Howard Hughes Medical Institute Assistant Investigator at Baylor College of Medicine in Houston Texas, before moving to the European Molecular Biology Laboratory in 1993. In 1996, he became Head of the Developmental Biology Unit at EMBL. In 2007, he moved to Singapore to take a position as Executive Director of the Temasek Life Sciences Laboratory. In 2008, he was elected as a Fellow of the Royal Society of London. Dr Cohen serves on the editorial boards of Science, Genes and Development, Developmental Cell and as an Editor of Developmental Biology. His research over the last decade has focused on morphogen gradients, growth control and metabolism and more recently on microRNAs in development and disease.

Collaborator:

- Dr Gerald Rubin (HHMI)

Title: An Integrated Approach to Overcome Sarcopenia and Frailty in Ageing Humans

Ageing is associated with a progressive and involuntary loss of muscle mass known as sarcopenia. Between the ages of 50 and 80, muscle mass is reduced by approximately one-third resulting in a significant decrease of muscle strength, with consequent frailty, and a high risk of metabolic syndrome. Sarcopenia has far-reaching consequences for the elderly, including impaired physical function, increased risk of falls, fractures, dependency, and in some extreme cases, death. In the year 2000 alone, sarcopenia was found to be the 6th leading cause of death and it was estimated that 1.5% of total health care expenditures in the United States, totalling $18.5 billion, was attributable to sarcopenia.

Singapore is the third fastest ageing nation in the world and the statistics predict that 20% of Singapore's population will be 65 and above in 2020. Looking forward, sarcopenia will be a tremendous burden on state funded health care systems such as Singapore's. Therefore, the impact on the Singaporean economy of even a modest reduction in sarcopenia would be appreciable. Therefore, this research programme proposes to develop biomarkers for early detection and therapeutics to overcome old age related muscle wasting.

Associate Professor Ravi KAMBADUR
School of Biological Sciences
Nanyang Technological University

Associate Professor Ravi Kambadur has a PhD in Biochemistry and Genetics. After completing a postdoctoral fellowship at National Institute of Health in Bethesda USA, Dr Kambadur moved to New Zealand in 1996 and was employed as a Principle Scientist at AgResearch. Here, Dr Kambadur discovered bovine myostatin gene and its mutations that lead to increased muscle growth and developed potent peptide myostatin antagonists that reduced age related muscle wasting seen during sarcopenia in mice. Recently Dr Kambadur moved from New Zealand and joined the School of Biological Sciences at the Nanyang Technological University as an Associate Professor in 2007 where he is continuing his research on sarcopenia.

Co-Principal Investigators:

- Associate Professor Peter Droge (NTU)
- Associate Professor Mridula Sharma (NUS)
- Associate Professor Stacey Tay (NUS)
- Associate Professor Reshma Merchant (NUS)
- Dr Barry P Pereira (NUS)
- Eugene Makeyev (NTU)

Title: Autologous Cell Therapy for the Ageing Heart Using Reprogrammed Cells

Induced pluripotent stem (iPS) cells can be obtained by reprogramming human (of all ages) skin fibroblasts. Like embryonic stem cells (ESCs), iPS cells have strong potential of reconstituting all tissue types in the body. However, unlike ESCs, these iPS-derived cells and tissues can be returned to the patients without the complications of immunorejection and ethical concerns. This finding has brought forward strong interest in applying patient-specific and self-tailored iPS cells for safe and effective cell therapy for our rapidly ageing population.

With our expertise in ESC biology, in vivo cardiac cell therapy, and tissue engineering, we propose a project aiming to explore the usefulness of patient-specific iPS cell-derived cardiomyocytes and endothelial cells to repair chronic heart diseases. Skin fibroblasts will be obtained from patients to make iPS cells using safe and clinically acceptable procedures. Heart muscles will be made from these iPS cells and transplanted to animal models to test their safety and feasibility for future clinical applications. This will pave the way for a pioneer clinical cell therapy study with patients' own iPS cells to improve quality of life for heart disease patients.

This is a project with technological advances that could benefit cardiovascular disease, diabetes and other degenerative diseases. Importantly, patients' own cells such as cardiac myocytes (normally unavailable) can be generated in the lab and serve as unlimited source of replacement cells and also as unique cellular model for basic research to design better drugs. Successful completion of this project will bring about new treatment that affects a vast majority of patients in our rapid growing ageing society in Singapore.

Dr Winston SHIM
National Heart Centre

Dr Winston Shim is a Principal Investigator and Staff Scientist of the Stem Cell Laboratory of Research and Development Unit of the National Heart Centre. He is currently an Adjunct Assistant Professor at the Department of Surgery, National University of Singapore. He has been working on adult bone marrow-derived stem cells for autologous cardiac cell therapy since 2002. He was among the first to produce adult cardiomyocyte-like cells in culture for cell replacement therapy.

Co-Principal Investigators:

- Dr William Sun (ETC, A*STAR)
- Dr Heming Wei (NHC)
- Professor Gregory Dusting (BOBIM, Australia)

Collaborators:

- Dr Li Fern Hsu (NHC)
- Dr Yangzhen Shao (NHC)
- Dr Chong Hee Lim (NHC)
- Dr Yoong Kong Sin (NHC)
- Dr Philip Wong (NHC)

Title: Ischemic Stroke with a Focus on Intracranial Stenosis

There is no doubt that stroke, as well as many of its risk factors, is age-related. The risk of stroke mortality increases by 4-fold, while prevalence doubles with each decade of age in the age range of 50-90. With a rapidly ageing Singapore, coupled with the continuous rise in the prevalence of stroke risk factors in the population, stroke prevalence will increase exponentially over the next two decades, presenting a huge burden on healthcare, social services and the economy. Moreover, there is at present limited understanding of stroke etiology and even more limited effective treatment for stroke.

We therefore propose to study ischemic stroke with a focus on intracranial stenosis or intracranial large artery disease, which is the predominant stroke subtype among Asians. The objective is to understand better the mechanism of stroke, improve diagnostic and prognostic methods, improve patient care and treatment, develop new treatment modality including studying the feasibility of stem cell therapy. This will be a unique study of well phenotyped patients which will provide important information on novel risk factors and biomarkers for the diagnosis, progression and clinical prognosis of stroke patients with intracranial stenosis. Such new knowledge may lead to the identification of patentable new treatment targets and surrogate outcomes in clinical trials, and possibly resulting in improved therapeutic strategies and drug development for intracranial stenosis.

The team undertaking this research consists of thirteen clinician and basic scientists who are experienced in their respective areas of stroke research.

Professor Peter WONG
Department of Pharmacology
Yong Loo Lin School of Medicine
National University Health System

Professor Peter Wong joined the Department of Pharmacology at the National University of Singapore in 1982 as a lecturer. He is currently Professor and Head of Department. He is also Associate Editor of the journal Neurochemistry International. He has worked in the field of neurodegenerative diseases throughout his research career. He has published more than 90 research articles in peer-reviewed scientific journals.

Co-Principal Investigators:

- Prof Christopher Chen
- Prof K Jeyaseelan

Collaborators:

- Dr Bernard Chan
- Prof Wei Yi Ong
- Dr Evelyn Yim
- Dr Vijay Sharma
- Dr Raymond Seet
- Dr Hock Luen Teoh
- Dr N Venketasubramanian
- Dr Jiong Jiong Wang
- Dr Kai-Hsiang Chuang
- Dr Yiong Huak Chan

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