

Stem cell research

entrepreneurship and commercialization
in the Stockholm region

Background facts May 2015



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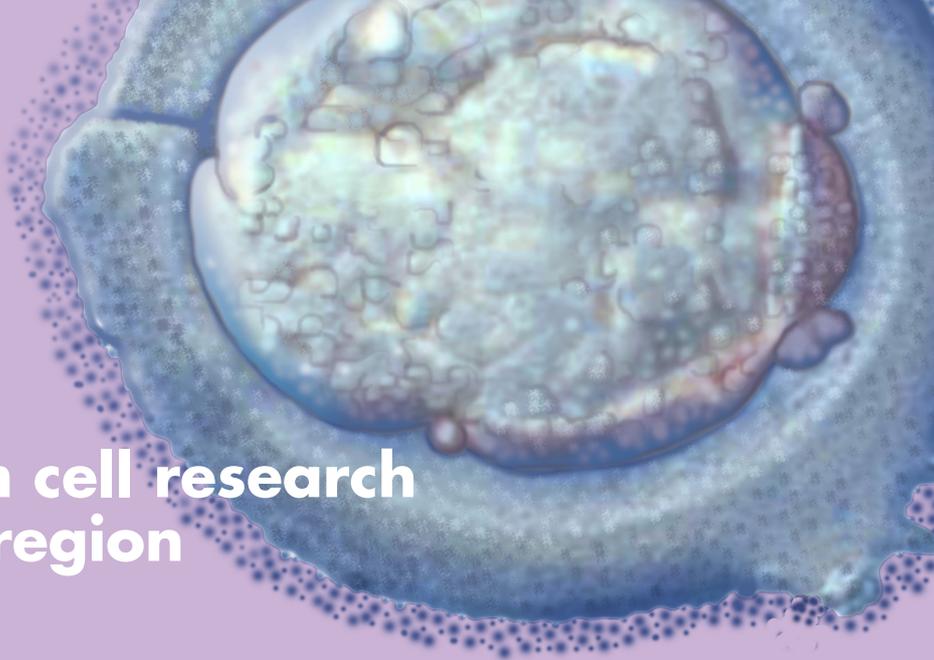
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Stated about stem cell research in the Stockholm region

- If you compare the number of articles on stem cell research that Karolinska Institutet gets published annually in international journals such as Cell, Science or Nature, then we are among the top ten in the world. We are on the cutting edge particularly in the field of nerve cell science. We can compete with universities such as Cambridge, Harvard, Stanford and the University of San Francisco, says Urban Lendahl, professor of genetics, secretary of the Nobel Assembly at Karolinska Institutet and director of operations at StratRegen at Karolinska Institutet in Stockholm.
- The Stockholm-Uppsala region has reached a critical mass of researchers and technology companies in the stem cell field, about which we are constantly exchanging ideas and thoughts, says Outi Hovatta, professor, fertility and stem cell researcher at Karolinska Institutet in Stockholm.
- Karolinska Institutet's collaboration with AstraZeneca's researchers is very unusual, and a type of collaboration I would like to see more of, says professor Kenneth Chien, who relocated his whole research team from Harvard to Karolinska Institutet in Stockholm.
- The big advantage of the Stockholm-Uppsala region is the intense collaboration between industry, research and the clinical side, says Per Lundin CEO of IsletOne which, by means of cell therapy saves the lives of those with life-threatening pulmonary and cardiac diseases.
- The future looks good for Karolinska Institutet. In recent years we have made five international top recruitments of professors, and the next generation – our young researchers – have received a large portion of the European Research Council's (ERC) research grants, says Urban Lendahl, professor of genetics, secretary of the Nobel Assembly at Karolinska Institutet and director of operations at StratRegen at Karolinska Institutet in Stockholm.
- Karolinska Institutet is an incredibly exciting environment for unlocking the potential of cutting-edge studies in fundamental stem cell biology towards new paradigms for regenerative therapeutics, says Kenneth Chien, professor at Karolinska Institutet in Stockholm.
- Generative medicine is a new field in which Karolinska Institutet is on the cutting edge. What sounded like science fiction only ten years ago is not that today. One example is that, in the past, it was difficult to study human nerve cells because they have to be obtained directly from patients. Now, using new methods, we can reprogram skin to become embryonic stem cells, so-called IPS-cells. From a single stem cell, we can then culture an infinite number of stem cells that in turn can then be transformed into any type of cell in the body, for example nerve cells that are used to treat and research into Parkinson's disease." Anna Falk, professor of stem cell research at Karolinska Institutet in Stockholm.
- The International Society for Stem Cell Research (ISSCR) is thrilled to bring its 15th annual meeting to Stockholm, a city that shares our passion and reputation for great scientific research and collaboration. From the outset, the city has been a generous and enthusiastic partner, recognizing what the meeting means to the scientific community, whose members will travel from all corners of the world for one very special week in Stockholm, says Nancy Witty, CEO.

Sweden creates opportunities

In Sweden there is a political and economic will to invest in research in life science which creates rich fertile ground for different types of investment in the Stockholm-Uppsala region. Research with all types of stem cells and production methods has been possible in Sweden since 2002 thanks to legislation that strongly promotes science and development. The regulations assume, just as Alfred Nobel formulated his prize, to be able to achieve the greatest possible benefit for mankind.

” I was positively surprised. The regulations support research in a better way in Sweden than they do in the USA, says American Kenneth Chien, previously researcher at Harvard and who, since 2013, has been doing research on cardiac stem cells at Karolinska Institutet.

Powerful investments in the future

Swedish researchers and politicians strongly believe that stem cells may cure many of our serious diseases in future. The research is financed primarily by government grants, but also by EU contributions, regional support, insurance companies and trusts.

” Sweden has a very good pool of “soft financing”, says doctor Per Lundin CEO for IsletOne that has created a cell therapy that has saved the lives of people with cardiac and pulmonary diseases.

Biobanks

Approximately 600 biobanks are registered and accessible for research in Sweden. The most extensive one is the PKU biobank that contains blood samples from almost all those born in Sweden after 1975.

The Swedish Twin registry

The world's largest twin registry was established in the 1960's and contains information about approx. 85,000 identical and fraternal twins.

Research and progress in the region

For a long time, Stockholm has had a leading role as an innovative and high-tech center. Research in the region has been awarded by 17 Nobel prizes over the years. According to cardiac stem cell researcher Kenneth Chien, who chose to relocate his operations from Harvard to Karolinska Institutet in Stockholm, the success will surely continue. He believes that the region will become the hub for a new generation of startups in biotechnology.

” In Stockholm, researchers receive great, long-term support from both the authorities and the regulations, which means better opportunities for research than in many other countries. Another strength is the well-documented medical care of patients that has contributed in making an enormous quantity of clinical data available in various registers and biobanks. Furthermore, a large proportion of the population speak English and the Swedish lifestyle attracts international expertise. Karolinska Institutet has all the ingredients needed to attract world-class researchers to Stockholm, says Kenneth Chien.

Stem cells the key to self-healing brains

Today it is not possible medically to repair a brain that has become damaged by disease, violence, or trauma. In stem cell research, there is a potential to treat even these types of damage – by stimulating the brain to repair itself. This is what Patrik Ernfors, professor of molecular neurodevelopment at Karolinska Institutet in Stockholm, together with his research group, hope to achieve by their research. It is believed that the decisive factor lies in understanding the mechanisms behind the division of stem cells, and in studying this, Patrik and his team are essentially unique in the world. [Read more](#)

Knowledge about newborn brain cells may offer treatment for anxiety and stroke

Professor of stem cell research Jonas Frisé's research group at Karolinska Institutet in Stockholm investigated the incidence of carbon-14 in the brains of dead people and, by doing this, could measure the number of newborn brain cells. Further research showed that newborn nerve cells in the human brain migrate to a structure in the brain called the striatum, in contrast to that in animals in which they migrate to the olfactory bulb. This discovery, which was presented in 2014 in the journal *Cell* 2014, may lead to new methods of treating diseases such as depression, anxiety, stroke and Huntington's disease. [Read more](#)

How stem cells are affected by inflammation

At Karolinska Institutet in Stockholm, professor Lou Brundin is leading a research group at the Department of Clinical Neuroscience, that is one of Europe's largest MS-centers. They are looking at mechanisms that cause immature stem cells to become activated and are partly able to repair an injury to, or inflammation in, the nervous system. Immature cells can develop into, among other things, new oligodendrocytes – the cells that are damaged in the disease multiple sclerosis. They are also investigating how stem cells are affected by inflammation. [Read more](#)

One of the world's largest stem cell banks and future in vitro fertilization

Professor Outi Hovatta at Huddinge university hospital in Stockholm was first in the country to cultivate stem cells from human embryos. Together with her colleagues at Karolinska Institutet, she has created a system of saving stem cells from the embryo that is implanted in a woman during in vitro fertilization. Today, together Karolinska Institutet and Karolinska University Hospital have one of the world's largest stem cell banks with approximately 70 stem cell lines and Stockholm supplies the whole world with stem cells for research. For several decades, the donors have also had access to their own stem cells that can be used to cure future disease in their family or relatives. [Read more](#)

Self-renewal, pluripotency and large-scale cultivation

The knowledge we have about what steers the differentiation (maturation) of stem cells is limited. Cecilia Annerén's research group at Uppsala University is doing research into what external factors and signal pathways steer the division of stem cells, their pluripotency and survival. A large part of their research consists in developing concrete methods for cultivating stem cells on a large scale.

[Read more](#)

Researchers solve the ethical dilemma of stem cells

In 2014, an international research team led by Karl Tryggvason of Karolinska Institutet, presented a novel method for manufacturing embryonic stem cells on a large scale and at the same time the embryo survives. According to Tryggvason, from an ethical point of view, this novel method of harvesting stem cells is not more remarkable than a blood test. Before the method was developed, stem cells were obtained from residual human embryos from test-tube-fertilization with the result that they became inviable. Now it is possible to re-implant the embryo without risk of damaging it. At Karolinska Institutet it is common practice, in conjunction with test-tube-fertilization, to extract a cell from the embryo to see whether it contains any serious hereditary diseases. When it has been established that this is not the case, then the embryo is re-implanted in the mother's uterus.

” Many children have been born after this procedure, says Outi Hovatta professor, fertility and stem cell researcher at KI in Huddinge.

[Read more](#)

Synthetic proteins can help researchers to cure Parkinson's disease

Part of the same research project as above. After ten years of research, a group at Karolinska Institutet in Stockholm led by professor Karl Tryggvason and professor Outi Hovatta has succeeded in making a synthetic human protein which normally is produced by the embryo itself. Previously, stem cells were cultivated on proteins from animals or other human cells that resulted in a low production of stem cells which, furthermore, were not pure and, theoretically, could harm the patient. The new method produces completely pure cultures of which the researchers know every molecule in the environment. According to the researchers, the method means that in future stem cells can be produced on a large scale with the degree of purity that is required for use in drugs, to replace damaged cells and, hopefully, to cure diseases such as Parkinson's and diabetes. [Read more](#)

Harvard professor relocates his research to Karolinska Institutet in Stockholm

With his research, professor Kenneth Chien wants to create a new method that will induce the damaged heart to heal itself. At Harvard, Chien succeeded in getting mouse hearts to do precisely this, but when, in 2013, it was time to take a step further and do research on human stem cells, it emerged that Stockholm and Karolinska Institutet was the right alternative, because the conditions for conducting clinical studies are more favorable than in the USA. Now the focus is on creating a molecular atlas of the heart's development and to see which signals steer the renewal of cardiac cells. This may also be interesting to help us better understand the genesis of congenital heart defects and to discover new methods for regenerative cardiology. The research group hopes soon to be able to carry out the first human study of modified mRNA. [Read more](#)

Stem cell transplantation leads to a breakthrough in the treatment of type 1 diabetes

Olle Korsgren is professor of transplantation immunology at Uppsala University and research into diabetes and possible methods of preventing and curing the disease. One project that he is running together with, among others, Per-Ola Carlsson, researchers and physicians at Uppsala University Hospital, is focusing on the possibility of combating diabetes in newly diagnosed patients by transplanting stem cells with immuno-inhibitory properties. For the first time ever, the group has treated patients with newly diagnosed type 1 diabetes using their own stem cells. The results were published in 2014 in the scientific journal *Diabetes*, with the conclusion that it is a safe and promising strategy for stopping the destruction of beta-cells in type 1 diabetes.

” **One year after treatment, the patients had preserved and, in some cases, improved insulin secretion, says Per-Ola Carlsson, diabetes physician at Uppsala University Hospital and professor of medical cell biology at Uppsala University.**

[Read more here](#)

Researchers in Stockholm behind breakthrough in cancer research

In 2014, researchers at Karolinska University together with colleagues at Oxford University presented a breakthrough in cancer research that may lead to more effective treatments. The researchers succeeded in showing that the source of all cancer cells is a small group of cancer stem cells, the only cells in the body that can ensure that the malignant tumor continues to grow.

” **It is like finding the root of a weed. If you remove the root, then the cancer disappears. Out of all the patients we studied, there was not one single genetic mutation that did not derive from these rare stem cells, says Sten Eirik W. Jacobsen, professor at MRC Weatherall Institute of Molecular Medicine in Oxford and visiting professor at Karolinska Institutet.**

In 2014, the Royal Swedish Academy of Sciences awarded Eirik W. Jacobsen with Sweden's most prestigious individual research prize, the Tobias prize. The reason for this was: “for groundbreaking scientific contributions to the field of haematopoiesis, particularly with respect to identifying factors that regulate the maturation process of haematopoietic stem cells, factors of great importance for successfully transplanting stem cells”. [Read more here](#)

Stem cells and the genesis of malignant brain tumors

At Uppsala University, Professor Karin Forsberg Nilsson is leading a research team that is investigating how stem cells develop into malignant tumor cells and how these cancer cells interact with healthy brain tissue in order to be able to multiply. The objective of the research is to produce markers that can be used to predict, and develop methods of, treating cancer. [Read more](#)

Basic research will reveal the biological processes of stem cells

Jonas Muhr is professor of eukaryotic molecular biology at Karolinska Institutet and is doing research into the biological processes of proteins and other macromolecules. Among other things, he is trying to understand how a stem cell gets its instructions and is looking specifically at how neural stem cells are regulated for formation of the brain. [Read more](#)

Mesenchymal stem cells suppress inflammation

The research group of physician and professor Katarina Le Blanc at Karolinska Institutet in Stockholm is investigating connective tissue stem cells. These mesenchymal stem cells (MSC) can produce bone, cartilage, and fat and, in addition, are immunosuppressive. Their research has shown that treatment with MSC significantly improves the condition of patients after blood stem cell transplantation. In collaboration with other researchers and institutions, the group is running various pilot projects on inflammatory diseases including multiple sclerosis and diabetes. [Read more](#)

Driving forces behind stem cell research in the Stockholm region

Karolinska Institutet

Karolinska Institutet in Stockholm is one of the world's leading universities, ranked among the 10 best medical universities in the world. In Sweden, Karolinska Institutet produces just over 40 per cent of the academic medical research and offers the greatest range of medical courses. Karolinska Institutet is affiliated with Karolinska University Hospital where the clinical trials of drugs/therapies are conducted. Since 1901, the Nobel Assembly at Karolinska Institutet, has been nominating the recipient of the Nobel prize in physiology or medicine.

StratRegen

Research in stem cell biology and regenerative medicine is a specific strategic field that is being conducted by StratRegen at Karolinska Institutet. They are working with embryonic stem cells, neural stem cells and hematopoietic allogeneic stem cell transplantation and are focusing on five main areas:

- 1. Cell differentiation at the molecular level**
- 2. Steering of the differentiation of stem cells toward medically interesting cell types**
- 3. Transplantation biology**
- 4. Elucidating the developmental lines of cell types**
- 5. Biomaterials for the differentiation and transplantation of stem cells**

[Read more](#)

StratRegen is also responsible for strategic recruitment. In recent years, the following researchers have been recruited, among others:

- Kenneth Chien (cardiology), Harvard
- Paolo Macchiarini, (ear-, nose- and throat) honorary professor University College, London
- Molly Stevens (Biomedical Materials), Imperial College, London
- Stephen Strom (pathology/liver), University of Pittsburgh
- Sten Eirik W Jacobsen (hematology), Cambridge

Top researchers from Oxford fortify Karolinska Institutet

Professor Sten Eirik W. Jacobsen, head of stem cell biology at the University of Oxford, and visiting professor at Karolinska Institutet in Stockholm. Here, he is leading a newly started center for research in hematology and regenerative medicine (HERM). The project is the result of a large endeavor to attract international top researchers to Karolinska Institutet. In May 2014, the Swedish Research Council decided to grant Karolinska Institutet 522 million Swedish kronor (MSEK) to recruit internationally eminent researchers. The money is spread over ten years and is being used to establish four research environments of leading international caliber. [Read more](#)

DBRM A Linnéus Center in Developmental Biology for Regenerative Medicine

DBRM is a research center at Karolinska Institutet in Stockholm, and functions as a know-how hub for the Swedish research community in the fields of developmental biology, stem cell research and neurobiology. DBRM consists of thirteen research groups, all with leading international expertise. The vision is to understand the molecular structure behind stem cell differentiation and a cell's "developmental destiny" in order to find new patterns within cellular transplantation and regenerative medicine. With the purpose of strengthening collaboration between the clinical sciences, they are creating a Translational Research Center (TREC) for the rapid transfer of new data in clinical environments and, in addition, they have started a new research school. [Read more](#)

Liver Cell Laboratory

A section of the unit for transplantation surgery at Karolinska Institutet in Stockholm. The research group is working on the isolation and transplantation of hepatocytes that can be used to treat liver diseases. Liver tissue that cannot be used for transplantation is used for basic research which includes the study of drug metabolism, toxicity, synthesis and canalicular transport. The laboratory is co-operating with, among others, researchers at Uppsala university, AstraZeneca USA, in Germany and Israel. [Read more](#)

Theme Center for Regenerative Medicine

A collaboration between Stockholm County Council and Karolinska Institutet with the purpose of promoting the transfer of basic research to clinical applications. The research is focusing on three major diseases: Parkinson's disease, multiple sclerosis and blood diseases that can be cured using allogeneic stem cell transplantation. [Read more](#)

The Swedish Medical Nanoscience Center

Karolinska Institutet in Stockholm is working on integrating nanotechnical methods and medical research that, in future, may lead to new therapies and the development of medical-technical equipment. This includes supporting the commercialization of medical innovations. TSMNC works as an interdisciplinary (medicine/technology) know-how hub in both the Swedish and the international arenas, in which researchers in many different fields collaborate. The latest research is primarily on neuroscience, infection biology and general cell biology. However, these fields will be expanded to include a number of others, such as cancer and diabetes. [Read more](#)

Uppsala University

Uppsala University, Sweden's first university, is ranked among the 100 best universities in the world. Here, for over 500 years, it has conducted world-leading research and first-class education. Uppsala University is an eminent seat of learning dedicated to science and higher education with international cutting-edge research in a number of faculties that has drawn attention through eight Nobel prize winners.

StemTherapy

Stem Therapy is one of the biggest Swedish projects ever in stem cell research and is a collaboration between the universities of Uppsala and Lund. The objective of the research program is to develop cures, treatments and diagnostic methods for diabetes, stroke and blood diseases. [Read more](#)

OTOSTEM

Substantial progress has been made in the efforts to restore hearing in recent years. Researchers at Uppsala University Hospital/Uppsala University are working together in OTOSTEM, a newly started EU-project that, with the help of stem cells in combination with cochlear implants, is concentrating on recreating more hearing ability and offering deaf people and those with substantially impaired hearing a better quality of life. [Read more](#)

SciLifeLab Stockholm

SciLifeLab is a joint endeavor involving four Swedish universities, Karolinska Institutet, the Royal Institute of Technology, Stockholm University and Uppsala University, to build up an infrastructure for world-leading research in the fields of health science and ecology. [Read more](#)

Companies and collaboration in the Stockholm region

Moderna Therapeutics Sweden

Moderna is an American biotech company that working on the chemical modification of Messenger RNA (mRNA Therapeutics) that is used in the treatment of serious diseases. The company has recently established its first subsidiary abroad in Stockholm at Karolinska Institutet. [Read more](#)

Translational Science Centre

Together, AstraZeneca and Karolinska Institutet have created a research center for translational research in the fields of cardiovascular and metabolic diseases and regenerative medicine. They are conducting preclinical and clinical studies in order to increase the understanding of the pathophysiological processes in cardiovascular and metabolic diseases.

Vecura

Vecura is an endeavor at Karolinska University hospital run and financed by the county council and which manufactures stem cells and vectors for the development of gene therapy drugs (ATM Advanced Therapy Drugs) in accordance with Good Manufacturing Practice (GMP). Since its establishment in 1996, over 300 patients have been treated with the help of Vecura's vectors. Many of the therapies used are very close to those used in medical care; often they involve the transplantation of cells. [Read more](#)

” What is very appealing about Karolinska is that we have the entire chain from basic research to the patient. We can do everything on site. There is a very well established infrastructure, everything can be done within Karolinska's walls, says Pontus Blomberg, director of operations at Vecura.

” Vecura is an invaluable key player, company and researcher in the region, ... says Henrik Nittmar, CEO Coreline a spin-off-company from Pharmacia that is creating cell therapies for seriously ill patients with type 1 diabetes.

Cellaviva

In 2015, in conjunction with the company Cellaviva's opening of Sweden's first commercial biobank for umbilical cord blood, it also started a biobank to facilitate research in the field. Umbilical cords, so-called Wharton's jelly, are rich in mesenchymal stem cells. These are called connective tissue stem cells and can develop into various types of tissue such as bone, cartilage, tendons, muscles and fat. [Read more](#)

BioLamina

The company develops, manufactures and distributes solutions for the culture of primary cells and stem cells. The company is based on a scientific foundation with an inheritance of matrix biology and considerable experience of cell-culture-based research. With the technique that BioLamina has produced, it is now possible to culture stem cells with greater control and with enhanced definition. [Read more](#)

IsletOne Therapeutics

The company develops cell-based therapies for the treatment of cardiac, inflammatory and autoimmune diseases. They have a phase I-study of inflammation in progress and a first-in-man clinical study in the field of cardiology. [Read more](#)

Coreline

Coreline was established by three previous employees of Pharmacia in Uppsala which, today, is a section of Pfizer/GE. The company develops biocompatible solutions based on its CHS™ heparin-coated surface technology. Heparin is a naturally occurring substance in the body that is used routinely in surgery as a pharmaceutical anticoagulant so that the formation of blood clots can be avoided. The company is now conducting first-in-man studies of diabetes 1.

3HBiomedical

The company develops, manufactures and sells 150 types of cell-based products for research, drugs, chemical screening and the development of biomaterials. The company collaborates with companies including ScienCell Research Laboratories in San Diego. [Read more](#)