Content

1 World-leading hub for oncology 3
  Statements about cancer research and entrepreneurship in the region 4

2 The region’s Nobel laureates 6

3 Centers of excellence 7
  Karolinska Institutet and Karolinska University Hospital 7
  Uppsala University and Akademiska University Hospital 8
  Royal Institute of Technology 9
  Stockholm University 9
  The Stockholm School of Entrepreneurship 10
  Ludwig Cancer Research 10

4 World leading research creates possibilities 11
  Selection of current research projects 11
  Other discoveries and innovations with significant impact on current cancer research, diagnostics and treatment 14

5 Unique biobanks and data registers 16
  Some of the region’s biobanks 16

6 Commercialization innovations 18
  Some of the region’s companies within oncology 18

Contact:
Ylva Hultman-Erlandsson
Business Development Manager
Stockholm Business Region Development AB
Phone  +46(0)8 508 280 65
Mobile  +46(0)70 472 80 65
Email  ylva.hultman@stockholm.se

Åsa Andersson, Ph.D.
Medical/Scientific Advisor
Stockholm Business Region Development AB
Phone  +46 (0) 8 508 280 48
Mobile  +46 (0) 70 472 80 48
Email  asa.andersson@extern.stockholm.se

Stockholm Business Region Development
invest@stockholm.se
+46 8 508 280 00
www.investstockholm.com
www.stockholmbusinessregion.com
Follow us on our website/twitter/YouTube: .com/investstockholm
youtube.com/stockholm
Cancer research and its related commercial enterprises in the Stockholm-Uppsala region, are leading the way in this area. This is not a coincidence.

There is a longstanding history of collaboration in the Life Sciences sector between universities, industry and hospitals, which has nurtured the development of multinational pharmaceutical businesses in the region, including Astra, today a part of AstraZeneca, and Pharmacia, now a part of Pfizer. This unique approach will soon be amplified further with one of Sweden’s largest urban development projects ever, Hagastaden – a world class science city.

The region outperforms in relation to its size with regard to innovation and infrastructure. In 2015, Stockholm was the most popular Nordic city for international companies to set up regional Northern European headquarters and was ranked second in Europe in scale up according to the European Digital City Index. Sweden as a whole was ranked third in the world in innovation according to the Global Innovation Index and is also the world’s third most IT-mature country, according to the 2015 Global Information Technology Report.

The legacy of Nobel and free university studies has created an advanced and pioneering workforce. It was a worldwide noteworthy event when a woman with a uterine tumor received proton radiation at Svedberg laboratory in Uppsala in 1957. In the 1960s and 1970s, George and Eva Klein, pioneers in immunotherapy, lay the foundation for the region’s prominent position in cancer research. Their department at Karolinska Institutet attracted many foreign researchers and became a world-leading hub for tumor biology.

1. World-leading hub within oncology
Statements about cancer research and entrepreneurship in the region

The best center for cancer research outside North America*
Karolinska Institutet is the highest ranking research institute in oncology outside of North America and consequently a natural partner for Roche which helps us continue to be a world leader in precision medicine. Karolinska Institutet has proven that it has both the organizational and visionary capabilities of collaborating with large international companies.

Public Policy Manager at Roche, Dec 2015

I am very proud and thankful for being trained at Karolinska Institutet*
Tomas Lindahl, Nobel Prize winner in Chemistry in 2015 made his Nobel Prize-winning discoveries at the Karolinska Institutet in the 1970s. He identified how cells repaired damaged DNA and safeguards the genetic information. This has provided important information on how the cell works and formed the basis for the development of new cancer treatments.

Interview with Tomas Lindahl in Svenska Dagbladet, Dec 2015

A particularly attractive environment*
Uppsala University offers a particularly attractive environment both for the high number of experimental research groups working in this particular field and for the lasting and strong collaboration with the clinicians. Furthermore, highly efficient facilities allowing studies of genomics and proteomics or robotic screenings of thousands of drugs and chemicals would also strongly accelerate our research.

Elisabetta Dejana, Professor, Department of Immunology, Genetics and Pathology, Uppsala University, Dec 2015.

Rivals Silicon Valley in breeding startups* Silicon Valley may be the most famous birthplace of billion-dollar tech companies; second place goes, improbably, to Stockholm.

From a Politico article by Sami J. Anteroinen, Nov 2015.

They are way ahead of us in the precision medicine game*
“Sweden is already doing it,” said Kathie Olsen, Managing Director of ScienceWorks. Why is that? First, the government offers support for translating research into commercial products, explains Uppsala researcher Tobias Sjoblom. Another part comes down to culture: “People are not very mobile — they stay where they are, for the most part,” which makes them easier to find for research. The final piece of the puzzle is Sweden’s excellent registries, which track most of what goes down, medically, in the whole population.”

From a Politico article by Arthur Allen, Sep 2015

The whole mindset has led to a very tech-savvy population*
Kartik Hosanagar, wrote in a Forbes article “How Stockholm became a ‘Unicorn Factory’, Nov 2015
The partnership between MD Anderson and Karolinska Institutet is a great example. "Cancer is one of the biggest challenges of our times, and to beat it we need to bring together the strengths of the top cancer fighting institutions across the globe. The partnership between MD Anderson and Karolinska Institutet is a great example of this, and we work together across the entire continuum of clinical care, research and education to end cancer."

Oliver Bogler, Senior Vice President Academic Affairs, MD Anderson, Dec 2015

The competence found here will help us improve our therapy development globally. Our collaboration with Karolinska Institutet will allow for the comparison of Swedish registry data with evidence from across the globe, to better understand and compare patient outcomes in the complex and diverse setting of real life. This data will help us understand patient needs over the duration of a lifetime, and in doing so, allow for better drug development and trial design. The effects of novel, targeted oncology treatments can be estimated using this historical data, and by doing so, allow for better assessments of potential outcomes from new interventions. Collaboration is fundamental for this type of research, requiring input from clinicians, biologists, statisticians, epidemiologists, and computer programmers. Sweden has been a leader in this field to-date and the competence found here will help us improve our therapy development globally.

Johan Liwing, Director Market Access RWE Partnerships, Janssen, Dec 2015

The region offers a unique opportunity to develop a world-leading precision cancer medicine program. Combining the technological capabilities at Science for Life Laboratory with high-profile basic cancer research as well as clinical collaborations and biobanks in the region offers a unique opportunity to develop a world-leading precision cancer medicine program. This will have an impact on patient care and build a base for major industrial collaborations.

Olli Kallioniemi, MD, PhD, Director of the Science for Life Laboratory, Professor of Molecular Precision Medicine, Karolinska Institute, Jan 2016

An exceptional hub for excellent scientific collaborations. Karolinska Institutet has always been a reference for research at a global level. We are focusing on the discovery and development of new anti-cancer drugs, and the Stockholm-Uppsala axis, including the Science for Life Laboratory, is an exceptional hub for excellent scientific collaborations.

Oskar Fernandez-Capetillo, guest researcher at Karolinska Institutet, Dec 2015

I choose to work in this region because of the wonderful concentration of resources. I would say that I choose to work in this region because of the wonderful concentration of resources, and the overall quality of life, and the collaborative nature of the people in the Stockholm-Uppsala region.

Randall S. Johnson, Guest Professor at Karolinska Institutet, Dec 2015.
2. The region’s Nobel laureates

The legacy of chemist, entrepreneur and Stockholmer Alfred Nobel strongly permeates the region. Tomas Lindahl, winner of the Nobel Prize in Chemistry in 2015 is the 31st Swede to receive a Nobel Prize since 1903 and the 24th from the Stockholm-Uppsala region.

Chemistry
1. Svante Arrhenius, Stockholm University (1903)
2. Theodor Svedberg, Uppsala University (1926)
3. Hans von Euler, Stockholm University (1929)
4. Arne Tiselius, Uppsala University (1948)
5. Tomas Lindahl, PhD at Karolinska Institutet (2015)

Physiology or Medicine
1. Allvar Gullstrand, Uppsala University (1911)
2. Hugo Theorell, Karolinska Institutet (1955)
3. Ragnar Granit, Karolinska Institutet (1967)
5. Torsten Wiesel, Karolinska Institutet (1981)

Physics
1. Gustaf Dalén, worked in Stockholm (AGA) (1912)
2. Manne Siegbahn, first worked at Lund University and Uppsala University, then at the Royal Swedish Academy of Sciences (1924)
3. Hannes Alfvén, worked at the Royal Institute of Technology (1970)
4. Kai Siegbahn, worked at Stockholm University, Uppsala University, Royal Institute of Technology (1981)

Economic Sciences
2. Bertil Olin, worked at the Stockholm School of Economics (1977)

Literature
1. Tomas Tranströmer (2011)

Peace
1. Klas Pontus Arnoldson (1908)
2. Hjalmar Branting (1921)
3. Nathan Söderblom (1939)
4. Dag Hammarskjöld (1961)
5. Alva Myrdal, worked on different public service tasks in Stockholm (1982)
3. Centers of excellence

Stockholm-Uppsala is the most prominent academic center in Northern Europe, attracting many foreign students and researchers. For over 500 years, Uppsala University has conducted world-leading research and provided a first class education. Karolinska Institutet in Stockholm is the ninth best medical university in the world according to the QS world university rankings for 2015/16. The Nobel Assembly at Karolinska Institutet nominates the recipient of the Nobel prize in Physiology or Medicine.

Karolinska Institutet and Karolinska University Hospital

Karolinska Institutet was established in 1810 in Stockholm, and today it produces 40 percent of the academic medical research in Sweden. Karolinska Institutet is affiliated with Karolinska University Hospital, where clinical trials are conducted. The hospital is currently being expanded and New Karolinska Solna is expected to be completed in 2018. Concurrently, two new research centers associated with Karolinska Institutet are being built, Neo and Biomedicum.

Highest ranking within oncology

According to bibliometric measurements carried out by the Swedish Research Council and the Swedish Cancer Society in 2015, Karolinska Institutet is the best research center for cancer outside North America.

Karolinska Institutet is a part of the Cancer Core Europe Consortium that includes six of the most prominent cancer centers in Europe. It was formed in 2014 and focuses on the development of personalized cancer medicine.

Cancer makes up more than 30 percent of the research volume at Karolinska Institutet, and is one of its two largest and most competitive research areas. KICancer is a network for cancer researchers from all disciplines including clinical research, nursing sciences, epidemiology and basic science.

In recent years, the following top level cancer researchers have been recruited:

**Lauri Aatonen**: Human tumor susceptibility (from University of Helsinki)

**Martin Bergö**: CAAX proteins (from Gothenburg University)

**Olli Kallioniemi**: Systematic precision medicine (from University of Helsinki)

**Oscar Fernandez-Capetillo**: Replication stress as anti-cancer therapy (from the Spanish National Cancer Research Centre)

**Pekka Katajisto**: Tissue homeostasis loss and aging (from University of Helsinki)

**Randall S. Johnson**: Effects of hypoxia in physiological and pathological contexts (from University of Cambridge)

**Sir David Lane**: p53 cancer protein, which he also discovered (from A*Star, Singapore)

**Sten Eirik W. Jacobsen**: Regulation of normal and malignant hematopoiesis (from University of Oxford)
StratCan
The strategic research program in cancer combines cancer research with clinical oncology by bringing together top level cancer scientists from different disciplines. StratCan collaborates with two world-leading American research institutes, MD Anderson Cancer Center and Mayo Clinic. They also work with pharmaceutical companies, Roche and Janssen Pharmaceuticals, whose Stockholm investment is the largest within the company’s global Real World Evidence network.

BRECT
Jonas Bergh, Professor of Oncology, is director of BRECT, a theme center for preclinical breast cancer research. BRECT focuses on key signaling pathways in breast cancer cells such as Hedgehog, Notch and PAK4, as well as signaling in tumor stromal cells and signaling between the cancer cell and stroma. Research ranges from studies with cell lines, animal models and patient biopsies to potential clinical studies and clinical trials.

Radiumhemmet
Karolinska University Hospital’s cancer clinic, Radiumhemmet, conducts patient-related research in order to improve diagnostics, treatment and care. The Cancer Research Foundations of Radiumhemmet supports about 100 research projects. In the past year, special focus has been placed on personalized cancer medicine.

Development platform for E-health
In March 2015, KI Holding presented HIP.se, a health innovation platform that provides developers and entrepreneurs with a tool for developing E-health services. It also provides researchers with the possibility of carrying out medical studies in an entirely different way. For example, compared to Apple’s Research Kit, HIP is also equipped with the security services demanded by the Swedish system.

Uppsala University and Akademiska University Hospital
Uppsala University was established in 1477 and has produced several Nobel Prize Laureates. It is ranked at position 81 (40 within Life Sciences) in the 2015-2016 Times Higher Education World University Rankings. The University is affiliated with Akademiska University Hospital, which was established in 1708 and is where the clinical trials are conducted.

Personalized medicine with proton radiation and PET/MR Imaging
Uppsala researchers were pioneers with precise proton radiation therapy. In 1957, Uppsala was second after Berkeley in the U.S. to introduce the technology. Since 2015, all proton radiation in Sweden takes place at the new Skandion Clinic in Uppsala. For a time, integrated PET (position emission tomography) and MR (magnetic resonance tomography) have been used at Akademiska University Hospital, making quicker diagnoses and accurate therapy selection possible and allowing the effects of cancer treatment to be assessed at an early stage. The Uppsala PET center is well known for its established PET chemistry with the largest track-record in the world of bringing new PET ligands into man. Uppsala provides both pre-clinical PET/MR camera and clinical PET/MRI system.

International referral center for neuroendocrine tumors
The Department of Endocrine Oncology at Uppsala University was appointed as The National Referral Center for Endocrine Tumors in 1986. About 20 percent of current patient referrals come from Europe, the United States, South America and Asia. The center is now considered unique in the world and has been involved in establishing Scandinavian, European and North
American networks for patients with neuroendocrine tumors. Britt Skogseid, chief physician, Professor of Tumor Biological Endocrinology at Uppsala University and honorary member of the American Association of Endocrine Surgeons is linked to the center. Among other things, she has conducted a randomized phase III study of survival for different cytotoxic treatments of adrenocortical carcinoma.

**U-CAN – Longitudinal cancer biobanking**

U-CAN was conceived as a new strategic program to structure and perform cancer biobanking to meet the needs of modern translational cancer research in academia and industry. It aims to become an international leader in terms of longitudinal biobanking of certain cancers; create a database of easily-searchable longitudinal information on a large number of patients; and be the substrate for competitive translational and clinical cancer research. So far colorectal-, hematological-, prostate-, brain-, neuro-endocrine-, gynecological-, breast- and lung cancers have been included, and over the long term, all tumor types will be covered. U-CAN has initiated research collaborations with several SMEs and leading pharmaceutical companies as well as international cancer institutes. In the international panel’s assessment, it received the highest rating in the evaluated categories, with the remark that the biobanking platform provides a strategic basis for research growth and an attractive area of research.

**Royal Institute of Technology**

The Royal Institute of Technology was founded in 1827 and is Sweden’s largest technical university. It accounts for one third of the country’s technical research. The Royal Institute of Technology has extensive international research and educational exchanges. Within the area of cancer, among other things, research on different physical and chemical diagnostic methods is performed, but also therapies such as radiation, complex polymer materials for different drug-delivery systems and lab-on-a chip technologies and protein pharmaceuticals.

**ProNova VINN Excellence Centre for Protein Technology**

ProNova Centre for Protein Technology performs multi-disciplinary research in protein technology, including technology-driven research in protein engineering, bioimaging, micro-fluidics, affinity technology, biomarker discovery and analysis. The center is collaborating with the Human Protein Atlas program that provides the world’s largest set of antibodies and recombinant human protein fragments and eight companies in the life science sector.

**Wallenberg Centre for Protein Research to open in 2016**

As a continuation of the Human Protein Atlas, a new protein research center, the Wallenberg Center for Protein Research (WCPR) will open in 2016. AstraZeneca is financing a part of the activities. The Center will be led by Mathias Uhlén, Professor of Microbiology, who led the Human Protein Atlas project. Research will be carried out at the Science for Life Laboratory, Uppsala University and Chalmers University of Technology. Furthermore, the Center will characterize human protein, but also develop protein pharmaceuticals and new techniques for manufacturing such pharmaceuticals.

**Stockholm University**

Stockholm University is Stockholm’s largest university. Its researchers contribute to the development of public policy and political decision-making, as well as participate in Nobel Prize Committees and international expert bodies.
The Stockholm School of Entrepreneurship

The Stockholm School of Entrepreneurship is an internationally acknowledged academic facility in the area of innovation and entrepreneurship. It was founded by the Royal Institute of Technology, The Stockholm School of Economics and Karolinska Institutet to develop an integrated teaching syllabus to meet the demands of students, faculty and industry. Today Stockholm University and University College of Arts, Crafts and Design have joined as member institutions.

Science for Life Laboratory

Science for Life Laboratory is a joint endeavor, involving four universities in the Stockholm-Uppsala region, Karolinska Institutet, 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. Science for Life Laboratory was established in 2010 and over 200 research teams are connected to the center.

On behalf of the Swedish Research Council, two international research panels have assessed the research center during 2015. Among other things, they have concluded that the project maintains very high scientific quality and that Science for Life Laboratory has great potential to become a world leader in Life Sciences.

Ludwig Cancer Research

Ludwig Cancer Research is a community of the world’s leading scientists, all pursuing innovative ways to prevent and control cancer. The Ludwig Institute for Cancer Research has an expansive research presence through its branches and collaborative laboratories around the world.

Two of the organization’s 13 branches are in Sweden, one at Karolinska Institutet and one at Uppsala University.

The Uppsala branch focuses primarily on signaling pathways that control cell growth. The work is led by Carl-Henrik Heldin, Professor of Molecular Cell Biology and chairman of the Nobel Foundation. The Stockholm branch focuses on research primarily in signaling through growth factors, stem cells and cell differentiation. The work is led by Thomas Perlman, Professor of Molecular Development Biology and member of the Nobel Assembly at Karolinska Institutet.
4. World leading research creates possibilities

This region has a tradition of research, with extensive experience in registry studies and intensive cooperation between academia and the cluster of bio-/medtech and pharma companies. Furthermore, it is not the university but the researchers themselves who have ownership of their patentable inventions.

Selection of current research projects

New treatment causes brain cancer cells to explode
Glioblastoma is one of the most difficult forms of cancer to treat. In 2014, Patrik Ernfors, Professor of Tissue Biology at Karolinska Institutet together with researchers at Uppsala University discovered that the substance Vacquinol-1 causes brain cancer cells to explode. Vacquinol-1, which is primarily used for treating malaria, increases the growth of vacuoles. These small blisters consist of cell membranes and transport substances into the inside of the cell. The new formation of vacuoles goes into overdrive due to Vacquinol-1, and ultimately the cell membrane bursts and the cancer cell dies. Research is now being carried out to develop a “glioma cell blaster” for cancer care.

Knowledge about blood vessel leakage can provide new treatments for brain cancer
Substances such as water, ions and proteins leak out through the entire length of blood vessels. If the vessels release too much water, an edema (accumulation of water) forms. They are common in cancer, and many times prevent pharmaceuticals from reaching the cancer cells. In 2015, a research project was started around the mechanisms behind edema formation. The project was titled “Towards control of formation and resolution of edema by deciphering mechanisms of vascular leak and lymphatic function”. The project is being led from Uppsala University by five directors of research: Christer Betsholtz, Professor of Vascular and Tumor Biology; Lena Claesson-Welsh Professor of Vascular Biology; Elisabetta Dejana, Professor of Pathology; Taija Mäkinen, university lecturer and Katie Bentley, previously Assistant Professor at the Computational Biology Laboratory, Harvard Medical School. Increased knowledge about this can provide new treatments for brain cancer, for example.

Karma – one of the world’s largest breast cancer studies
Karma is one of the world’s largest breast cancer studies and the world’s best characterized cohort. The project is led from Karolinska Institutet by Per Hall, Professor of Radiation Epidemiology, and Johan Bergh, Professor of Oncology. The objective of the project is to map which women have an increased risk of developing breast cancer, and if they develop the disease, to identify which of them have an increased risk of dying from the disease. So far, more than 70,000 women have chosen to take part in the Karma Project. The study contains different interim reports, such as the effect of the drug Tamoxifem and whether infrared imaging could complement mammography.

A lack of oxygen affects the spread of cancer
Hypoxia is a condition that involves the body’s tissues not getting enough oxygen. A lack of oxygen is part of the final stage in all diseases, especially cancer. Tumors can survive with less oxygen than healthy tissues. Randall S. Johnson, Professor of Molecular Biology and Hypoxia Biology at Karolinska Institutet and his research group have shown that the hypoxia-induced
factor 1-alpha, which reacts to hypoxic changes, affects, among other things, cancer cell development. In their ongoing research, among other things, they track the formation of new blood vessels, angiogenesis, which is one of the hypoxic mechanisms during cancer development. The tumor must form new blood vessels in order to spread and utilize the lack of oxygen to metastasize via the blood vessels. A hypoxic cancer cell moves to search for oxygen and invades the body more aggressively.

**STHLM3 – one of the world’s largest research projects within prostate cancer**

With its 60,000 participants, STHLM3 is one of the world’s largest research projects in the field of prostate cancer.

The project has tested a new diagnostic system for detecting aggressive prostate cancer at an earlier stage compared to current PSA samples, which cannot distinguish between aggressive and non-aggressive prostate cancer. Henrik Grönberg, chief physician and Professor of Cancer Epidemiology at Karolinska Institutet, leads the study. The STHLM3-test, which is based on the results from the THLM3 study, is performed with a blood sample and analyzes a combination of six protein markers, 200 genetic markers and clinical data. The test has been developed by researchers at Karolinska Institutet in collaboration with Stockholm County Council and Thermo Fisher Scientific in Uppsala. In practical terms, the test will not only result in an increased chance of early detection of aggressive prostate cancer, but also conclude in less false positives. In addition, fewer patients are subjected to the discomfort and side effects that tissue samples and treatment can cause.

**Precision treatments for lung cancer – part of the European Platform**

Professor of Oncology, Rolf Lewensohn and his group are focusing on the development of novel treatments for lung cancer. Their aim is to develop new oncological treatments in the form of novel drug candidates and precision radiotherapy, with a personalized cancer medicine approach. The group has a leading role in the Eurocan Platform, an EU-funded project that brings 28 European cancer institutions and organizations together. Within Karolinska Institutet and the Karolinska University Hospital, Rolf Lewensohn is the primary initiator of the development of a personalized cancer medicine program.

**Mapping genes that affect breast and colon cancer**

Cancer is primarily a genetic disease in which gene mutations can result in uncontrolled cell growth. Tobias Sjöblom, Associate Professor of Tumor Biology at Uppsala University, has mapped 280 genes that affect breast and colon cancer. His research group in molecular cancer genetics is now working on mapping additional, mutated genes that affect breast and colon cancer. In addition, they are working with new methods to identify the genes for example with blood samples instead of biopsies.

**Leukemia drug can be used preventively against hereditary colorectal cancer**

Glivec (imatinib) has been used in the treatment of chronic myeloid leukemia and has markedly reduced mortality of this disease. In 2015, Jonas Frisén, Professor of Stem Cell Research at Karolinska Institutet and his colleague Sven Pettersson, Professor of Metabolic Diseases, presented a study on tumors in a mouse model and from patients. It shows that the drug can also be effective for FAP, which is a hereditary polyps disease that can easily develop into colorectal tumors. The effect of imatinib affects ephrin receptor EphB, which stimulates the growth of polyps in the intestines and also slows down the transmutation of polyps to cancer.

**Cancer cells on a starvation diet**

Sugars are an important source of energy for cancer cells. Breast cancer cells in particular contain a large amount of Glucose transporters (GLUT) which are proteins that transport sugar into the cells. Researcher David Drew comes most recently from Imperial College London, but moved his research of transport proteins in the cell membrane to Stockholm University when
he received a scholarship from Wallenberg Academy Fellows. Together with researchers from Great Britain and Japan, he discovered how fructose is transferred into the cells at an atomic level. The study was presented in 2015 but research is continuing regarding the development of a molecule that blocks the transport proteins and thus starves the breast cancer cells.

**General anti-cancer drug without side effects**

A research team under the leadership of Thomas Helleday, Professor of Chemical Biology at Karolinska Institutet and Science for Life Laboratory, has together with four other universities, among others Stockholm University and Uppsala University, found a general treatment for cancer. By inhibiting the MTH1 enzyme, damaged building blocks can be inserted into the tumor’s DNA, which will ultimately kill it. MTH1 works as a cytostatic, but there are no side effects. The treatment also seems to be dependent on which genetic changes exist in different forms of cancer. Interim results of the study were presented in 2014 and clinical trials commenced at the end of 2015.

**On the way to cracking the DNA grammar code**

Genetic make-up contains information about an individual’s risk of developing diseases, e.g. cancer. The sequence of the genetic alphabet, A, C, G and T, make up the genetic code. However, to obtain information that can result in medical benefits; we must also have an understanding of what the sequences of letters mean, i.e. an understanding of the genome’s words and grammar. Jussi Taipale, Professor of Medical Systems Biology at Karolinska Institutet, and his research team have previously identified DNA words that are recognized from individual transcription phrases. Their most recent study looks at which combined DNA words the different pairs of transcription codes are bound to. The origin of completely new words that are formed by combining two words shows that the grammatical code is very complicated. The study that was presented in 2015 gives us an understanding of how genes are normally regulated and in cancer.

**Cancer app creates experienced security in the home**

In collaboration with companies, Karolinska Institutet has produced several patient apps for a number of diseases, including patients being treated for prostate-or breast cancer using radiation or chemotherapy. Via the app, patients can report their status to the clinic on a daily basis which makes it possible to assess the efficacy of treatment and any side effects. The app also provides evidence-based, self-care advice and provides an alert depending on the symptom the patient has reported. The cancer app has been developed by the Health Navigator Company in collaboration with patients, healthcare personnel and the research group led by Ann Langius-Eklöf, Professor of Nursing and Care. In 2012, the research group carried out the first study of the app showing that patient involvement allows the patients to feel secure and safe in terms of care services, despite the fact that they are receiving the treatment mostly at home. The group is now continuing research to determine whether the app can identify serious symptoms at an even earlier stage, which could result in fewer visits to the clinic and even reduce the workload at the clinic.

**Discovered the key to cancer**

In 2014, researchers at Karolinska Institutet, 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. One of the scientists behind the discovery is Sten Eirik W. Jacobsen, Guest Professor of Stem Cell Biology and Regenerative Medicine at Karolinska Institutet.
A platform for precision medicine for different types of cancer
Since the fall of 2015, Olli Kallioniemi, Professor of Molecular Precision Medicine at Karolinska Institutet and Director of Science for Life Laboratory, has been leading a project for creating a platform for systematic precision medicine. The research group is currently studying how cells and tumors from 500 cancer patients respond to 461 cancer drugs and are mapping the genetic and molecular factors that impact the effects of these drugs. For example, it may show how the tumor cells adapt to treatments and how resistance occurs.

Other discoveries and innovations with significant impact on current cancer research, diagnostics and treatment

Inventor of radio surgery
Lars Leksell, Professor of Neurosurgery at Karolinska Institutet, invented surgical techniques using radiation. In 1972 he established his company, Elekta, and commercialized the Leksell Stereotactic System and Leksell Gamma Knife. The company has now a range of tools and treatment planning systems for radiation therapy, brachytherapy and radiosurgery, as well as workflow enhancing software systems across the spectrum of cancer care. Elekta solutions are used in over 6,000 hospitals worldwide, and nearly half the sales of the company’s equipment are in the United States.

X-ray method with high image quality can detect hard-to-detect cancers
Mats Danielsson, Professor of Medical Imaging Technology at the Royal Institute of Technology, has developed an x-ray method that can detect breast cancer at an early stage. Most modern CT scanners these days cannot count individual photons and miss 30% of breast cancer cases. Danielsson’s method uses a detector that counts every photon, which improves image quality without raising the radiation dose. Alternatively, the radiation dose can be reduced without reduced image quality, for example when children are examined. The method can also be a significant factor in the detection of other forms of cancer. For example, it can distinguish between eight different colors and thus produce clearer images of tumors that are difficult to discern in an ordinary CT scanner. The system, which is owned by Philips, is available in hospitals around Sweden and in 40 other countries.

Pioneers within gastrointestinal cancer treatment
Bengt Glimelius, Professor of Experimental and Clinical Oncology, and the late Professor and gastrointestinal cancer surgeon, Lars Pålman, both at Uppsala University, have devoted a greater part of their working lives to researching bowel surgery. Among other things, they were involved early on with was preoperative radiotherapy for bowel cancer. Their work has resulted in a radical reduction in the recurrence of colorectal cancer. Bengt Glimelius still continues his research and was awarded the ESTRO Reguard medal in 2013 “in recognition of the enormous contribution he has made to the field of oncology, both in Europe and the worldwide community”.

X-ray tube for understanding tumor development
Hans Hertz, Professor of Biomedical Physics at the Royal Institute of Technology, is the man behind an x-ray tube based on “liquid metal jet technology”. This technology creates more photons per second per surface area compared to a traditional x-ray tube. The technology has been tested to reproduce thin blood vessels in the thick tissue of small animals and may be an important tool for research on the formation of new blood vessels, angiogenesis. Among other things, the formation of new blood vessels is a necessity for a tumor to be able to grow. The imaging technology can provide a better understanding of the growth factors of a tumor.
**Discovering NK cells**
During his doctoral studies in the 1970s at Karolinska Institutet, Rolf Kiessling discovered a hitherto unknown tumorcidal lymphocyte, which he named natural killer cell. These cells are an important part of the body’s defense against tumor cells and viruses. As Professor of Experimental Oncology and chief physician at the Radiumhemmet, Kiessling conducts research on immunotherapy, including among other things, genetically modified T-cells and checkpoint antibodies.

**Big pharma use software from the Royal Institute of Technology**
Calculation Biophysics solves problems using computers, and within the pharmaceutical industry, computer testing is very useful in the early stages of drug development. Among other things, Erik Lindahl, Professor of Biophysics at the Royal Institute of Technology and Stockholm University, often makes other advanced calculations of proteins that can provide more effective drugs for the treatment of cancer. He has led the international team behind GROMACS, one of the world’s fastest and most widely used software for drug development. Since computer testing at an early stage is very cost effective, there is a high demand for this technology. GROMACS is currently used in roughly 40 countries and by the world’s largest pharmaceutical companies.

**From idea to finished drug for prostate cancer**
Together with two Norwegian researchers, Sten Nilsson, Professor of Oncology at the Radiumhemmet at Karolinska University Hospital, has developed a drug that slows down advanced prostate cancer and extends survival. Xofigo (Radium 223) was approved in 2013 and is now used all over the world. A new substance, OsteoDex, is currently undergoing clinical testing in Sweden and Denmark.

**Further development of radio frequency ablation increases precision and reduces the spread of cancer**
Trinity is a method being developed using radio frequency ablation (RFA) – a treatment that entails an electrode being introduced into the tumor and then applied heat damages and kills the cancer cells. The heat treatment is cost effective as well as minimally invasive; however, RFA does have its disadvantages. In the refined Trinity method, the electrode needle is inserted into the tumor in small steps requiring precision placement, and the specially designed anti-seeding technology prevents loosened live tumor cells from reaching the bloodstream and being spread further. The method has been developed successively for treatment of non-metastasized breast cancer and can subsequently be used for other forms of cancer and for treatment of metastasized cancer. Pathologist Gert Auger and Hans Wiksell, Professor Emeritus in the Clinical Application of Electromagnetic and Acoustic Energy Forms, both at Karolinska Institutet stand behind Trinity, as well as Chief Surgeon, Lars Löfgren at Capio Sankt Görans Hospital.
5. Unique biobanks and data registries

Samples from the healthcare sector have been registered in Sweden since the 1920s. Today approximately 600 biobanks contain several hundred million of samples that can be traced to a specific person or research sample. It is mandatory for care providers to report new discoveries of cancer to the Swedish Cancer Registry that maps all incidences of cancer in the country and how it changes over time.

Some of the region’s biobanks and registries

**The world’s largest twin registry**
Karolinska Institutet has the world’s largest twin registry. It was established in the 1960s and contains information about 85,000 identical and fraternal twins.

**The PKU registry covers almost all Swedes born after 1975**
As Sweden’s largest biobank, the PKU Registry at Karolinska University Hospital includes almost all Swedes born after 1975, i.e. about 3 million individuals.

**Lifegene – one of the largest health studies in the world**
The project is a prospective cohort longitudinal study intended to provide knowledge on how genes, environment and lifestyle affect health. In addition to cancer, it can also involve other diseases. Lifegene was started in 2010 and a half million Swedes will regularly provide samples and information for at least 20 years. The study will use high-tech tools within e-epidemiology to perform measurements and data collection. The project is being run by Professor Nancy Pedersen and Professor Jan-Eric Litton at Karolinska Institutet.

**The Human Protein Atlas – a database of the human proteome**
Mathias Uhlén, Professor of Microbiology at the Royal Institute of Technology, has been the leader of the Human Protein Atlas consisting of 13 million images of the proteins of the human body. Fredrik Pontén, Professor of Clinical and Experimental Pathology at Uppsala University, has also taken part in the project which was completed in 2014. An unexpected discovery in the work with the Protein Atlas was that almost half of 20,000 human proteins are base proteins that exist in all of the cells of the body. In addition, researchers found that very few proteins are unique to their respective tissues. This is of great significance for the pharmaceutical industry, since drugs affect proteins. If a drug targets a specific protein in the liver and the same protein also exist in the kidneys and brain, unexpected side-effects may occur. Approximately two scientific articles based on the Protein Atlas are published each day.
Human glioblastoma cell culture – a biobank of brain tumors

In 2015, Uppsala University and Science for Life Laboratory started a biobank that currently holds <100 cell lines from glioblastoma patient surgical samples. Each cell line can be linked to the originating patient, making it possible to correlate cell characteristics and patient survival. Lene Uhrbom, Karin Forsberg Nilsson, Sven Nelander and Bengt Westermark are the Research Managers behind the HGCC Biobank which is available to researchers around the world. Another possible area of application for the biobank includes comparative tests of potential new drugs.

U-CAN – a biobank for cancer

The healthcare integrated U-CAN infrastructure includes standardized, centralized and automated collection, handling and storage of information and patient samples from patients with prioritized cancer diagnoses aimed at covering 30 percent of Sweden’s cancer patients. U-CAN collects and organizes patient samples that are taken before, during and after cancer therapy. Patient data and radiological images are also collected. In this ongoing effort, 9,000 cases of colorectal cancer, hematological malignancies, lymphomas, brain tumors, prostate cancers, neuroendocrine tumors, gynecological cancers, breast cancers and lung cancers were included from 2010-2015. Tobias Sjöblom, Associate Professor of Experimental and Clinical Oncology at Uppsala University, is the project’s program director.

BBMRI.se – a national biobank for research

Stockholm BioBanking and Molecular Resource Infrastructure of Sweden, BBMRI.se is a national infrastructure for saving and analyzing biobank samples from patients and healthy volunteers. The infrastructure provides possibilities for discovering diseases at an early stage. Karolinska Institutet, the host university for BBMRI.se, and a further eight universities are partners in this collaboration. In 2014, BBMRI.se was selected as one of the four nodes in a European BBMRI-ERIC center for ethical and legal issues regarding biobanks.

Uppsala PET Center – an imaging “biobank” in progress

The clinical PET/MRI system within the Uppsala PET Center, founded in 2014, will also be used to create an imaging biobank, including approximately 4,000 subjects recruited from the U-CAN and EpiHealth cohorts under a 5-year period.
6. Commercializing innovations

The region has more than 600 biotech, medtech, pharma and platform companies. There are about 30 Life Science incubators and innovation facilitators. For example in 2015, The Uppsala Innovation Center was ranked as the world’s 10th best business incubator with a university connection by UBI Global. In 2015, Johnson & Johnson Innovations established a satellite office on the Karolinska Institutet campus. Here, Nordic researchers and companies have access to the company’s expertise and other resources that can contribute to commercializing discoveries and innovations within the life sciences.

According to SwedenBio’s report, “The Swedish Drug Development Pipeline 2015”, the drug pipeline is dominated by oncology projects. Of a total of 38 oncology projects in phase I-III, half of these are in the Stockholm-Uppsala region.

Some of the region’s companies within oncology

**Affibody**
*Offer:* Affibody develops protein-based therapeutics based on its technology platforms: Affibody® molecules and Albumod™.

*Problems they solve:* HER2 is a protein that is an important biomarker and target of therapy for approximately 30% of breast cancer patients. The PET imaging agent ABY-025, based on an Affibody® molecule, binds strongly to HER2, and has the potential to become a diagnostic routine for metastatic breast cancer patients.

**Aprea**
*Offer:* Mutations of the p53 gene occur in about 50 percent of tumors and can be found in almost all known human cancer indications. Aprea has identified small molecules that reactivate the p53 gene.

*Problems they solve:* The company’s first candidate drug, APR-246, has been tested in a clinical Phase I/II trial with promising results. APR-246 has the potential to be used, alone or in combination, in many cancers, since mutations in p53 are found in about 50 percent of all diagnosed cancers.

**Atlas Antibodies**
*Offer:* Atlas Antibodies manufactures and distributes over 18,000 highly characterized research antibodies against human proteins. Their products include polyclonal and monoclonal primary antibodies, blocking antigens, Mass Spectrometry (MS) quantification standards, and antibody panels. As of today they have 56,420 products and they are constantly developing new advanced antibodies and reagents for MS-based quantitative proteomics.

*Problems they solve:* Atlas Antibodies provide advanced research reagents targeting all human proteins to researchers worldwide.
**Axelar**

*Offer:* Axelar develops anti-cancer treatments that target the insulin-like growth factor-1 receptor (IGF-1R) signaling pathway and other targets. AXL1717, Axelar’s lead drug candidate, is an orally bioavailable, small-molecule with dual mechanisms of action. AXL1717 targets the IGF-1R signaling pathway without affecting the highly homologous insulin receptor as well as serving as a microtubule inhibitor.

*Problems they solve:* The IGF-1 signaling pathway is believed to play an important role in many cancers, including brain tumors, lung, prostate, breast and colorectal cancer. However, despite being widely regarded as a promising therapeutic approach, no drugs targeting this pathway have yet reached the market. Multifunctional, orally bioavailable drugs may present a radical new opportunity in this regard.

**Beactica**

*Offer:* Beactica is a specialist drug discovery company, utilizing its proprietary methodologies to evaluate the interaction of molecules in order to generate novel therapeutics. Beactica focuses on how molecular interaction analysis and structural information can improve and advance the development of high-quality, small-molecule drug leads.

*Problems they solve:* Beactica’s prioritized programs focus on epigenetic regulation of various cancer forms through the selective and reversible inhibition of lysine-specific histone demethylases. Significant research shows that inhibitors of this enzyme class can be used for the treatment of several common cancers. Furthermore, these enzymes are also important in other diseases that could potentially give Beactica’s compounds wider applications.

**Biovica**

*Offer:* Biovica’s validated DiviTum™ technology has documented ability to predict cancer treatment outcome with the potential of becoming a marker of therapeutic efficacy for new cancer drugs.

*Problems they solve:* Biomarkers can help assure that the right patient receive the right therapy at the right time, which can prolong life and improve patient outcome.

**C-RAD**

*Offer:* C-RAD provides products in Radiation Oncology, supporting integration in end-to-end multi-vendor treatment workflows, from the computed tomography room to the treatment room: Sentinel – 4D solution for CT simulation; Catalyst series – optical tracking system for patient positioning, real-time monitoring and respiratory gating in radiation oncology; Laser positioning system from Cyrpa – for patient setup in imaging room and treatment room; Gemini – flat panel detector for portal dosimetry.

*Problems they solve:* C-RAD’s solutions ensure high precision, safety and efficiency in advanced radiation therapy, helping to cure more cancer patients and improve their quality of life.

**Excillum**

*Offer:* Excillum has developed two technologies that redefine the x-ray. The MetalJet x-ray tubes are conventional micro-focus tubes where the solid-metal anode is replaced by a liquid-metal jet. The metal jet supports higher electron-beam power and can therefore generate higher x-ray flux. The second technological cornerstone of Excillum is the high-brightness electron beam design that was developed to meet the power-loading capability of metal-jet anode technology.

*Problems they solve:* The MetalJet x-ray can generate roughly 10 times the x-ray flux of a conventional solid anode x-ray source from the same source area. Excillum’s electron beam design is highly suited to micro- and nano-focus x-ray tubes, but can also be applied to other technologies that require a high brightness electron beam.
**DexTech**

*Offer:* DexTech develops candidate drugs mainly for prostate cancer. Their main product is OsteoDex, for treatment of skeletal metastases in castration-resistant prostate cancer (CRPC). Other drug candidates include SomaDex for treatment of some pituitary tumors, neuro-endocrine tumors and palliation of CRPC, and CatDex/GuaDex, the tech platform, with interesting properties of its own (anti-tumor, anti-microbial).

*Problems they solve:* DexTech’s primary focus is on continued development of OsteoDex, an active, disease-retarding candidate drug against CRPC. The potential for OsteoDex is significant, because there is a great unmet need for new, active treatments for cancer and because this particular product has proven to be very tolerable (low toxicity).

**ExScale Biospecimen Solutions AB**

*Offer:* ExScale introduces automated, next-generation technology for nucleic acid extraction from formalin-fixed, paraffin-embedded (FFPE) tissue sections using paramagnetic beads.

*Problems they solve:* New understanding about the genetic composition of different cancer types has led to tailored cancer treatments using molecular diagnostic tests. One critical aspect in molecular diagnostics is related to the quality of the results, which depends largely upon the quality of genetic input material used, for example DNA and RNA. Currently, there is a demand for robust and automated solutions for extracting nucleic acids; DNA and RNA, without compromising on quality. ExScale has developed the Next Generation Extraction technology NGEx™. NGEx is a novel technology for nucleic acid extraction and improves productivity for personalized medicine.

**Gradientech**

*Offer:* Gradientech provides its customers with assays for live cell imaging.

*Problems they solve:* The ability of cells to respond to gradients is essential to all aspects of developmental biology, and important for physiological and pathological organ function. This area of research is of increasing importance for scientists in the academic, pharmaceutical, and diagnostic markets. Traditional, cell-based assays on the market are end-point assays, where the important information on cell responses between start and analysis is lost.

**Glionova**

*Offer:* Glionova is developing a novel therapy aiming to selectively and efficiently kill Glioblastoma (GBM) cells by targeting a newly discovered vulnerability of the cancer cells, namely catastrophic vacuolization. Their lead compound GLN-1001, currently in preclinical development, has been shown to efficiently deplete cancer cells in animal models of GBM and significantly prolong survival, without apparent effects on host brain.

*Problems they solve:* GBM is the most common and most aggressive primary brain tumor. It is a devastating disease with marginal life expectancy and limited treatment options, necessitating the development of conceptually new therapeutic strategies.

**iCellate**

*Offer:* iCellate®’s instrument uses biomechanical characteristics to capture rare clones of Circulating Tumor Cells (CTCs) from the blood and does not rely on conventional cell surface biomarkers that often miss some important, heterogeneous and plastic cancer cells.

*Problems they solve:* Like many other cancer types the most common ones (breast, prostate, lung and colorectal) do metastasize. Blood analyses to find CTCs can be performed on subjectively healthy people for early detection of cancer, or those already afflicted by symptoms, to potentially guide their treatment and for follow up any recurrences for those already being treated.
Immuneed

Offer: Immuneed offers a therapeutic peptide vaccine candidate which is built on a unique, patent-pending innovation that will enhance both peptide drug uptake and activation of the cellular immune response to combat cancer. Their primary focus is advanced prostate cancer. They also provide a specialized service based on a human blood loop system for detection of immune-related side-effects of biopharmaceuticals to help predict outcomes in a clinical setting and thereby replace or complement animal studies.

Problems they solve: Treatment options for metastatic, castration-resistant prostate cancer (mCRPC) are limited and novel treatments have not yet been clinically successful. There is also a strong need for assays that can provide adequate information on immunotoxicity and immune efficacy of mAbs and other immune modulating drugs prior to clinical drug trials.

Kancera

Offer: Kancera has four pharmaceutical projects in its existing product development portfolio, in the disease areas of leukemia and solid tumors. The development of new drug types is being carried out as a close collaboration between clinical and industrial expertise. This creates the opportunity to make the risky development of new treatment methods more reliable.

Problems they solve: Kancera’s focus is on target molecules in the cancer, which opens up the possibility of reducing resistance in life-threatening forms of cancer and also the development of diagnostics that allow early identification of patients who will benefit from the new treatment.

Karo Bio

Offer: Karo Bio is a development company with a focus on broadening its activities to cover projects and products closer to market. The company has several projects on the way to the clinical phase. The estrogen receptor (ER) is activated by the hormone estrogen and regulates a number of functions in the body. ERbeta, which Karo Bio co-discovered in the 1990s, seems to mediate many of the positive effects of estrogen. Karo Bio’s most advanced compound within the ERbeta program is KB9520, which is in preclinical development.

Problems they solve: KB9520 has shown good efficacy for different forms of cancer. In these disease models, the treatment has demonstrated to significantly reduce tumor size due to the substance’s anti-proliferative and pro-apoptotic effects. Karo Bio’s development strategy is to initially focus on rare forms of cancer with the later possibility to expand to other forms of cancer.

Klaria

Offer: Klaria’s operations are based on a patented drug delivery platform in the form of an alginate-based polymer film. The film is similar to a small postage stamp, which discreetly attaches to the oral mucous membrane and distributes the medication rapidly and directly into the bloodstream.

Problems they solve: The films that exist on the market are ODF films (Oral Dissolvable Films), which work in an entirely different way to Klaria’s film: once they melt in the mouth, the substances are swallowed and absorbed in the intestine similar to normal tablets. With Klaria’s film, the medication is absorbed directly into the bloodstream via the oral mucous membrane, resulting in faster absorption and more reproducible effect.
Neo Dynamics

Offer: NeoDynamics is a medical technology company developing precision equipment for safe and qualitative diagnosis of breast cancer. NeoDynamics presents a new technology for achieving large histological samples when performing biopsies that, regardless of size and properties of the lesion, make it possible to precisely place an ultrasound-guided needle in the area from which the diagnostic tissue is to be taken. The technology enables the physician to precisely and seamlessly maneuver even large diameter needles into the tumor. This is achieved by the physician applying short mechanical energy pulses.

Problems they solve: The generally used spring-loaded Core Needle Biopsy devices do not allow the needle to be placed precisely, even with image guidance, due to its significant penetration speed and thrust length. This disadvantage is usually compensated for by increasing the number of tissue sampling procedures or the sample needle gauge size, which in turn results in increased patient discomfort due to augmented tissue destruction and bleeding.

Oasmia

Offer: Oasmia’s is developing a new generation of drugs within human oncology. Oasmia’s product Paclical® is approved for treatment of ovarian cancer in Russia, and it is in a clinical phase I trial for metastatic breast cancer. Two other product candidates are scheduled to enter clinical phase I trial for breast cancer.

Problems they solve: Oasmia is applying a type of nanotechnology where insoluble substances are contained within a water soluble enclosure, a so-called micelle. Only certain molecules, called surfactants (excipients), can form micelles. Oasmia’s proprietary excipient, XR-17, is based on Vitamin A. What makes XR-17 special is that it can also form micelles with water-soluble substances. This technique will allow, for example, two cytostatics to be given in a single infusion, when normally it would require two infusions. This is the principle behind Oasmia’s novel drug candidate OAS-19 and their approach to targeting various cancers.

Olink Bioscience

Offer: Olink Bioscience provides products and services for human protein biomarker research and development. Their solutions help scientists make research decisions through multiplex biomarker analysis. Olink’s tools help bring new insights into disease processes, improve disease detection, and contribute to a better understanding of biology.

Problems they solve: Each Proseek Multiplex panel is focused on a specific area of disease or biology, targeting 92 validated and exploratory biomarkers that have been carefully selected in collaboration with leading experts in the field.

Pelago Bioscience

Offer: Pelago Bioscience enables Drug Discovery by providing data using the patented CETSA® method. Its focus is to deliver physiologically relevant, high-quality, Target Engagement data to customers and collaborators enabling them to develop new, better and more effective drugs faster.

Problems they solve: By outsourcing Target Engagement quantification assays, risk can be reduced and project progression accelerated. Pelago Bioscience provides a service model and can also offer method sublicensing, tech transfer, as well as consulting and risk-shared collaborations.
Pharmacolog

**Offer:** DrugLog® provides fast and straightforward solutions for personnel at Pharmacies and Hospital wards to ensure that the “right patient receives the right drug with the right concentration”. DrugLog® is the first link in the subsequent development of new methods and procedures for adapting treatments of patients with intravenous medicines with a focus on the patient’s long-term quality of life.

**Problems they solve:** Chemotherapy administration is an error-prone, high-risk process. The number and complexity of chemotherapy regimens are increasing steadily. Most cytotoxic drugs have a narrow therapeutic range and dose adjustments are often needed. Cancer patients are particularly susceptible to drug interactions, and medication delivery is an intricate process, with each step being a potentially significant source of error.

Pledpharma

**Offer:** Pledpharma’s PledOx® project (calmangafodipir) is being developed with the aim of reducing the serious side-effects of chemotherapy treatment of colorectal cancer. By reducing the side-effects of the treatment, the patient feels better and the conditions for completing the intended treatment improves. PledOx® has recently been evaluated in a clinical phase IIb study (PLAINT). The results show that the drug candidate can prevent the generation of nerve damage in a clinically significant way in connection with chemotherapy treatment for advanced colorectal cancer and without negatively affecting the anti-cancer effect.

**Problems they solve:** Nerve side-effects during chemotherapy treatment in colorectal cancer can result in lifelong debilitating problems that can affect patient’s quality of life, often leading to a reduction of the prescribed cytotoxic dose or, in worst cases, complete cancelation of the treatment.

RaySearch Laboratories

**Offer:** RaySearch was founded in 2000 as a spin-off of Karolinska Institutet. In less than fifteen years, the company has become a world-leader in the field of advanced software for radiation therapy. RaySearch markets the RayStation® treatment planning system that is used in more than 240 cancer centers worldwide. In addition, RaySearch’s products are distributed through licensing agreements with leading medical technology companies. RaySearch’s software solutions are used by over 2,500 clinics in more than 65 countries.

**Problems they solve:** RaySearch is a medical technology company that develops software for radiation therapy of cancer. RaySearch’s vision is to improve the chances of survival and the quality of life in cancer patients by providing innovative software to clinics for more effective radiation therapy of cancer.

ScandiDos

**Offer:** With its Delta4Phantom product, now replaced by Delta4Phantom+, ScandiDos has taken a leading role with the Pretreatment Verification field, which constitutes a quality assurance system for modern radiation therapy of cancer. With Delta4 Discover, which will be released at the beginning of 2016, there is a possibility of performing radiation dose verification during treatment, thereby increasing the quality and safety of the treatment. ScandiDos’ measurement system and advanced calculation program will provide physicians, physicists and patients with a receipt that the advanced and complicated treatment can be delivered and has been delivered as planned.

**Problems they solve:** The conventional way of planning an evaluation with a gamma index, dose deviation and distance to agreement has limited information, and the measured discrepancy to the planned treatment is not directly related to the clinical relevance of the deviation. The accuracy and ability to provide relevant clinical data using ScandiDos is unique.
Sprint Bioscience

Offer: Sprint Bioscience develops drugs with a focus on cancer and metabolism. The company works with a broad portfolio and quickly develops parallel projects in the preclinical stage, up to the point when it has identified a drug candidate that is ready for clinical trials.

Problems they solve: Cancer cell metabolism differs significantly from that of the tissue in which the cancer arises. Cancer cells proliferate more rapidly than normal healthy cells and adapt their metabolism to enable faster formation of various cellular components such as nucleotides, amino acids and lipids. Altered metabolism is a critical step for cancer cell malignancy and survival, and is a unique feature of cancer cells. This makes it possible to develop safer cancer therapies that only affect cancer cells, reducing the risk of adverse effects.

Xbrane Biopharma

Offer: Xbrane Biopharma is a biopharmaceutical company specialized in high demand complex generics. The lead candidate is a GnRH analog for the treatment of prostate cancer with controlled release, called Spherotide. It is a generic version of the drug marketed under the names Decapeptyl®/Trelstar®/Pamorelin® with formulation for controlled release. The active substance in the drug is Triptorelin and the controlled release formulation is based on encapsulation in microspheres of a biodegradable polymer.

Problems they solve: Xbrane has the technological know-how to develop and produce generic drugs with a controlled release formulation, based on biodegradable microsphere technology. The company currently has five generic candidates in its portfolio based on this technology. Xbrane also has patented technology in protein production in E.coli. The uniqueness of the technology is the production yield achieved for selective, well-suited proteins. Over time, Xbrane has delivered multiple tailor-made protein production platforms to pharmaceutical and biotech companies globally, with an average increase of production yield of 8x. Academic studies have demonstrated a 50x higher production yield.

Xspray

Offer: XSpray’s focus is on producing formulations of protein kinase inhibitors (PKIs), which along with many oral targeted anti-cancer agents suffer from low absorption and high risk of adverse events due to the sudden increase of exposure. The RightSize™ technology is a product platform technology that overcomes the inherent drawbacks exhibited by many active pharmaceutical compounds.

Problems they solve: XSpray is working to overcome the significant problem of variable bioavailability due to pH dependent absorption, food effect and poor solubility in gastric fluid. Their new technology is enabling the production of nano-scale particles for use in drug production.