Annual review 2022

Karolinska Institutet

KAROLINSKA UNIVERSITY HOSPITAL

Karolinska Comprehensive Cancer Center

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Welcome to Karolinska CCC annual review 2022

Karolinska CCC (Comprehensive Cancer Center) continues to progress, partly through its own and internal development, but just as importantly together with the rest of the country and within the international network for academic cancer care. This is reflected in a continued increase in the number of unique patients, 66,049, visit us in 2022. More patients than ever have received treatment in clinical studies, demonstrating our dedicated ambition to advance cancer care. Through strategic collaboration with our international scientific advisory board, the Hospital and Karolinska Institutet have deepened their collaboration within the CCC even further, which manifested itself on our first CCC day in March 2022, but which is also expressed by the fact that we are now extending this to two days on 30–31 March this year.

Scientific excellence is a fundamental principle for Karolinska CCC, during the year many important research discoveries have been generated. This has led to a high level of publication in reputable high-impact journals.

During the year, we received Ukrainian patients in need of cancer care, while our commitment to the development of European cancer care accelerated through participation in a number of EU-funded development projects, in addition to the extensive collaboration between individual research groups and academic institutions.

In this annual review we provide further details showing very strong progress, but I would like to highlight some activities that will equip us even better for further development.

- We have clarified our organisation at section level and created three new Nursing Areas led by three Heads of Operations to strengthen our leadership.
- We have deepened our collaboration with Paediatric Cancer Care.
- Cancer Research KI has established a database of all principal investigators doing research in the area at Karolinska Institutet.
- We have increased our robotic capacity to 6 surgical robots.
- We have purchased state-of-the-art gene sequencing technology.
- We are planning a consolidating Precision Medicine Hub in Solna to strengthen diagnostics and research.
- We are planning for a distinct and powerful ATMP centre (advanced therapy medicinal products) in Huddinge.

So please, read on and be inspired ahead of this years continued progress, which will be even stronger.

Patrik Rossi
Managing Director, Theme Cancer.
Chairman, Board of Directors, Karolinska CCC.

The Karolinska Comprehensive Cancer Centre (Karolinska CCC) brings together excellence within basic research, clinical research, and highly specialised cancer care.

The centre is a joint initiative of Karolinska University Hospital and Karolinska Institutet. Karolinska CCC is Sweden's first accredited Comprehensive Cancer Centre.

The accreditation entails that the organisations meet the ambitious quality standards set forth by the Organisation of European Cancer Institutes (OECI) for the cancer care, research, and education.

Contents


Sjuksköterska

Mission and Vision

Our mission

Develop national and international networks to provide our patients with access to the best international knowledge and ensure that our practices are always the best possible to meet all cancer-related needs of cancer patients.

Increase knowledge and lead the development of clinical application of person-centred care and precision medicine diagnosis and treatment.

Lead the development of evidence-based practice, national and international treatment programmes and guidelines.

Develop more high-profile research platforms in precision medicine, cell and gene therapy and by providing a high-quality FAS I resource for drug trials and a professional clinical trial organisation.

Ensure that Karolinska CCC is the relevant and natural partner in national and international research and development projects in the Life Science sector and academia.

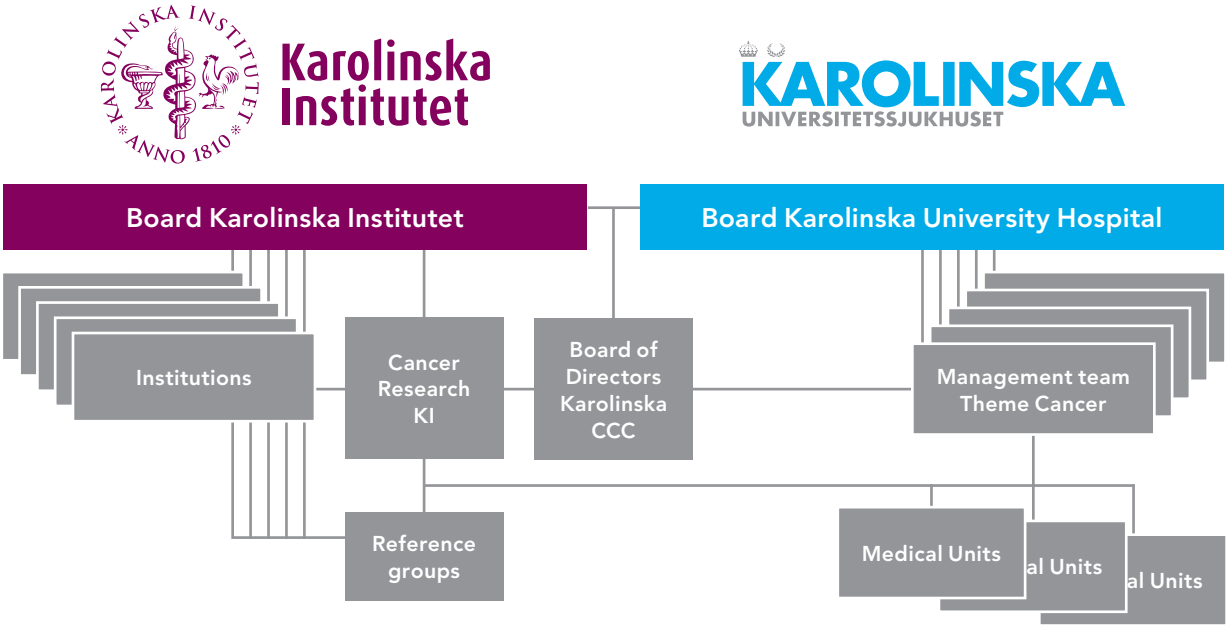
Systematically develop collaborations and partnerships with patients in order to increase patient participation to a greater extent in the development of care, research and education in the field of cancer.

Systematically develop data quality and data availability for easier and more continuous and transparent monitoring of quality of care, treatment outcomes, accessibility and patient experience in cancer care and research.

Long-term objectives 2022–2025

- The patient is an active partner – patient empowerment
- Precision health – we will offer all patients an individualized care and treatment strategy
- We are at the forefront of breakthroughs
- Sustainable skills development
- Increase international collaborations
- We are an excellent Comprehensive Cancer Center

Figure 1: Organogram Karolinska CCC.



Board of Directors (BoD)

In 2022, the BoD has been expanded with Nina Perrin who is head of operations from paediatric oncology/haematology within the Children's Theme at Karolinska University Hospital. Otherwise, the composition has been unchanged and BoD has met once a month. The work has been focussed on continued development of collaborations with national and international organisations and networks and active participation in conferences and meetings in cancer research and cancer care. BoD decided in July that Karolinska CCC would become a partner in the Nollvision Cancer innovation environment and to join two European consortiums with the aim of applying for grants within the framework of Horizon Europe, Cancer Mission.

Patrik Rossi
Managing Director, Theme Cancer, Karolinska University Hospital. Chairman, Board of Directors, Karolinska CCC.

Jonas Bergh
Professor in Oncology. Director CRKI, Karolinska Institutet. Prefect, Theme Cancer, Karolinska University Hospital.

Anna Martling
Professor in Surgery. Dean, Karolinska Institutet North. Senior Consultant, Theme Cancer, Karolinska University Hospital.

Stephan Mielke
Professor in Hematology and Cell and geneTherapy, Karolinska Institutet. Head of department, CAST. Research Director, Theme Cancer, Karolinska University Hospital.

Martin Bergö
Professor in Molecular Medicine. Vice President for Research, Karolinska Institutet.

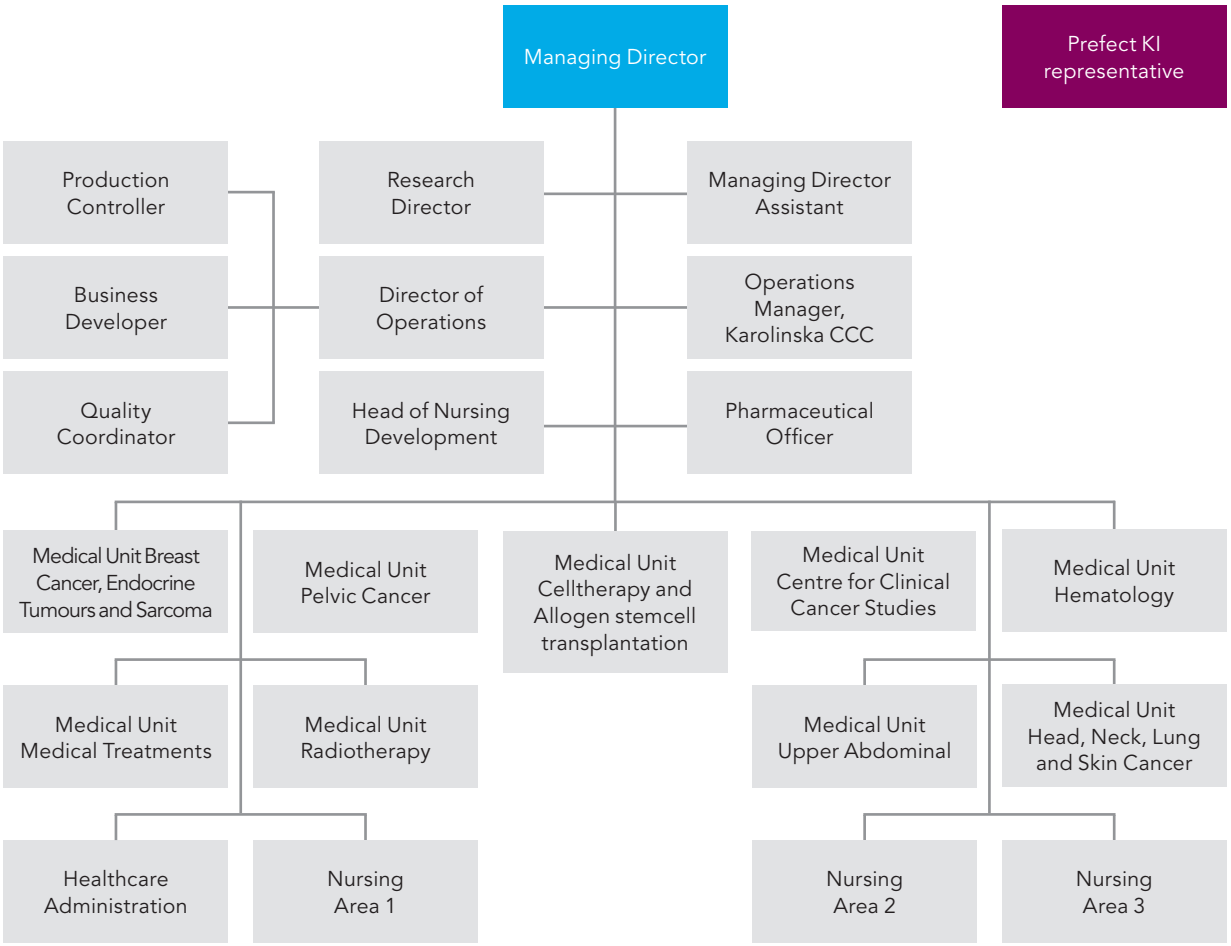
Yvonne Wengström
Professor in Nursing, Karolinska Institutet. Head of Nursing development, Theme Cancer, Karolinska University Hospital.

Janne Lehtiö
Professor in Proteomics, Karolinska Institutet. Research Director, SciLifeLab.

Nina Perrin
Head of Operations for paediatric oncology/ haematology, Theme Children, Karolinska University Hospital.

Eva Jolly
Operations Manager, Karolinska CCC.

Figure 2: Organogram Theme Cancer.



Theme Cancer

We are one of the largest themes at Karolinska University Hospital and conduct operations mainly in Huddinge and Solna but also has operations at Danderyd Hospital. We investigate, treat and care for patients with some form of malignant tumor disease. But we also care for patients who do not have cancer, i.e. benign conditions in areas such as urology, endocrinology, hematology and coagulation.

Theme Cancer works actively to take responsibility with other parts of the healthcare system to take responsibility for the patient throughout the care chain. We have a very close collaboration with Karolinska Institutet, which allows us to conduct extensive patient-centred clinical research and educational activities.

Camilla Hultberg, Operation Manager, Nursing Area 1

In 2022, Theme Cancer has undergone a reorganisation and established operational management areas for healthcare and appointed heads of section for oncology and surgery at the relevant medical units. The purpose of the changes is to mandate to drive development for common working methods, quality follow-up and to create better use of expertise.

The theme now consists of 13 operational areas including functions and administration. The new organisation involves three new operational managers nursing area. The reorganisation model is similar to the overall organisation of Karolinska University hospital and ensures nursing expertise in the management group.

Anna Wiberg, Operation Manager, Nursing Area 2

In 2023, through our organisational changes, we have improved opportunities to develop new ways of working together with ASIH and the palliative team and within the surgical areas. We will ensure good communication and feedback. We are introducing equal scheduling and staffing principles in our units that lead to more equal division of labour between staff and strengthen our continuity to patients. We will work towards equal working methods on the wards and thus providing more equitable care.

Ernesto Sparrelid, Operation Manager, Upper Abdominal

Cancer Research KI (CRKI)

Cancer Research KI is an umbrella organisation for all cancer research conducted at Karolinska Institutet (KI), and the guiding principles and overall objectives on which the activities are based and developed are: scientific excellence, education and innovation.

Scientific excellence is the foundation for Cancer Research KI's activities and many new important research discoveries have been generated, which is manifested in the form of a continued high level of publications in well-recognised high-impact journals both in clinical oncology/haematology, epidemiology and basic and basic science cancer research.

A further expression of the scientific excellence is also reflected in Cancer Research KI's contribution over the years to various strategic recruitments of well-reputed researchers. Our calls have included various forms of strategic research grants and support for relevant infrastructure; Taken together, these various initiatives clearly improve the conditions for cancer research of the highest quality.

Training the next generation of cancer researchers continues to be a high priority for Cancer Research KI through the investment in the clinical graduate school NatiOn (National research school in clinical and translational cancer research) and the doctoral programme FoTO (Doctoral Programme in Tumor Biology and Oncology). The strong investment in education constitutes a separate focus area in the organisation of Cancer Research KI, with a dedicated and competent working group.

Professor Jonas Bergh, Chairman CRKI

In order to support increased collaboration at different levels such as between clinical and pre-clinical research, between KI and Karolinska University Hospital, investment in collaborations at international and national level, and innovative research in collaboration with industry, Cancer Research KI has set up a database of all the principal investigators researching in the field of cancer at KI. The database provides important support for the organisation and generally increases knowledge about cancer research conducted at KI and about the expertise and knowledge the institute possesses. The database has proved invaluable in identifying potential partners for partners for industrial collaboration, international research collaborations and for internal needs when organising events and communication.
Link to the published database:
ki.se/en/cancerresearchki/cancer-research-ki-maps-cancer-research-across-ki

Johanna Furuhjelm, Administrative Manager CRKI

Cancer Research KI has expanded interactions with Mayo Clinic in the field of cancer, with several collaborations and grants in breast cancer research and since 2022 to also include other cancers.
Five researchers at KI were granted funding for collaborative for collaborative projects with the Mayo Clinic in areas including breast cancer, AI image analysis, p53, immunotherapy and leukemia. To support initiation of new valuable collaborations between KI and Mayo, joint digital research seminars are also research seminars are organised up to twice a year.

Cancer Research KI has continued to broaden its activities towards the public and a second event "A day for cancer research" was held in November 2022 with over 600 participants, a doubling of participation. The focus was this time on molecular diagnostics, stress and cancer, precision medicine, young people with cancer and breast cancer prevention.


Honeywell
Clearways
JIL

National and international cooperation and networks

In 2022, Karolinska CCC initiated a national network consisting of representatives from the three accredited Swedish Comprehensive Cancer Centres (CCC), which in addition to Karolinska are Sahlgrenska CCC and Skåne CCC. The aim is to share experiences, information and create conditions for development and cooperation within the framework of the CCC mission. Karolinska CCC also actively participates in a Nordic CCC network where we have identified strategic areas for collaboration and coordination of projects and initiatives in the Nordic region and in the rest of Europe. Both networks had their first meetings during Organisation of European Cancer Institutes (OECI) annual Oncology Days meeting; in 2022, the meeting was hosted by Valencia.

The OECI has published three "Excellent practices" from Karolinska CCC; "Ovala bordet – ett multiprofessionellt teambaserat arbetssätt" (The Oval Table - a multi-professional team-based approach), "Kontaktsjuksköterska" (Contact Nurse) and "Min Vårdplan" (My Healthcare Plan). As a result, other European centres have turned to Karolinska for support in the accreditation process. At the OECI meeting in Valencia, Eva Jolly presented the work with patient involvement and Yvonne Wengström presented how we have implemented and developed the work with contact nurses within Karolinska CCC.

Many employees have represented Karolinska CCC at scientific conferences and meetings during the year. During the Almedalen week in Visby, Patrik Rossi, Anna Martling and Janne Lehtiö from the Board of Directors participated in panel discussions. Maria Creignou, Ingela Berglund (patient representative) and Robert Bränström also gave presentations in Visby. In December, we were represented on delegation trips to India and Jordan with the aim of increasing our international contacts and future cooperations.

Stephan Mielke and Eva Jolly

Luigi de Petris, Stephan Mielke, Hildur Helgadottir and Olof Akre

Karolinska CCC is part of two consortia awarded two grants in 2022 within the "EU Cancer Mission", starting in 2023. This means that Karolinska CCC is strengthening its part in the European Commission's goal to improve the lives of more than three million people by 2030 by preventing, curing and improving the lives of those affected by cancer, including their families. The two projects are ECHoS and CCI4EU.

CCI4EU

The aim is to develop and improve existing or future Comprehensive Cancer Infrastructures in the EU by promoting research, innovation, and digital capacity development within cancer care. Karolinska CCC leads Work Package (WP) 2 together with the German Cancer Society (DKG).

ECHoS

The aim is to establish national cancer mission hubs in all Member States. Karolinska CCC is managing WP 6 together with Nollvision Cancer and the Swedish Municipalities and Regions (SKR), represented by the Regional Cancer Centre in collaboration.

The Karolinska CCC Day

In the spring of 2022, the first Karolinska CCC Day was organised, a day to celebrate and inspire employees and to highlight research and development within the field of cancer. The programme reflected preclinical, translational and clinical research along with examples of development work from the clinical activities. It was an appreciated day with participants from all professions, patients, researchers and students. The keynote speaker was Erlend Smeland, Chairperson of the Scientific Advisory Board (SAB). The moderator of the day was Olof Akre, who guided us through the day, which e.g., included presentations on the major advances made in recent years within research and treatment of malignant melanoma, lung cancer, and cell and gene therapy. One of the highlights of the day was when we got to experience live robotic surgery directly from the operating theatre under the guidance of Peter Wiklund.

Scientific Advisory Board (SAB)

At the end of March, we received a visit from the Scientific Advisory Board (SAB), an international scientific advisory body. The programme consisted of visits to Karolinska University Hospital and Karolinska Institutet in Solna and Huddinge, as well as a visit to SciLifeLab. Led by SAB Chairperson Erlend Smeland and drawing on a wealth of experience and expertise within cancer research, the meeting reviewed the progress of the Karolinska CCC to date and made recommendations for the next level of research excellence. The SAB report focuses on the following areas: organisation and management structure of Karolinska CCC, clinical studies including the Phase 1 unit and the Centre for Clinical Cancer Studies (CKC), radiotherapy, healthcare research, cell and gene therapy, and precision medicine.

Members of the SAB for Karolinska CCC:

- Alison Richardson, University of Southampton and University Hospital Southampton
- Cornelis van de Velde, Leiden University Medical Center
- Eric Lartigau, Centre Oscar Lambret, Lille
- Erlend B. Smeland, Oslo University Hospital and University of Oslo (chair)
- Josep Tabernero, Vall d´Hebron Institute of Oncology and Medical Oncology Department
- Julian Downward, Francis Crick Institute in London
- Laura Esserman, University of California San Francisco (UCSF) Carol Franc Buck Breast Care Centre
- Nancy Berliner, Brigham and Women's Hospital and Harvard Medical School

Members of SAB

Healthcare production and accessibility

The year 2022 has continued to be partly influenced by the pandemic with a focus on shortening the cancer care waiting lists that have arisen. After the summer of 2022, Karolinska University Hospital set the very ambitious goal of becoming the first Swedish university hospital without waiting lists. Structured work and strong efforts by the theme's staff have paid off - the number of people waiting more than 30 days for a new visit has decreased by about 90 percent. The good results are due to improved planning and coordination of existing resources, but also to additional efforts such as evening and weekend work.

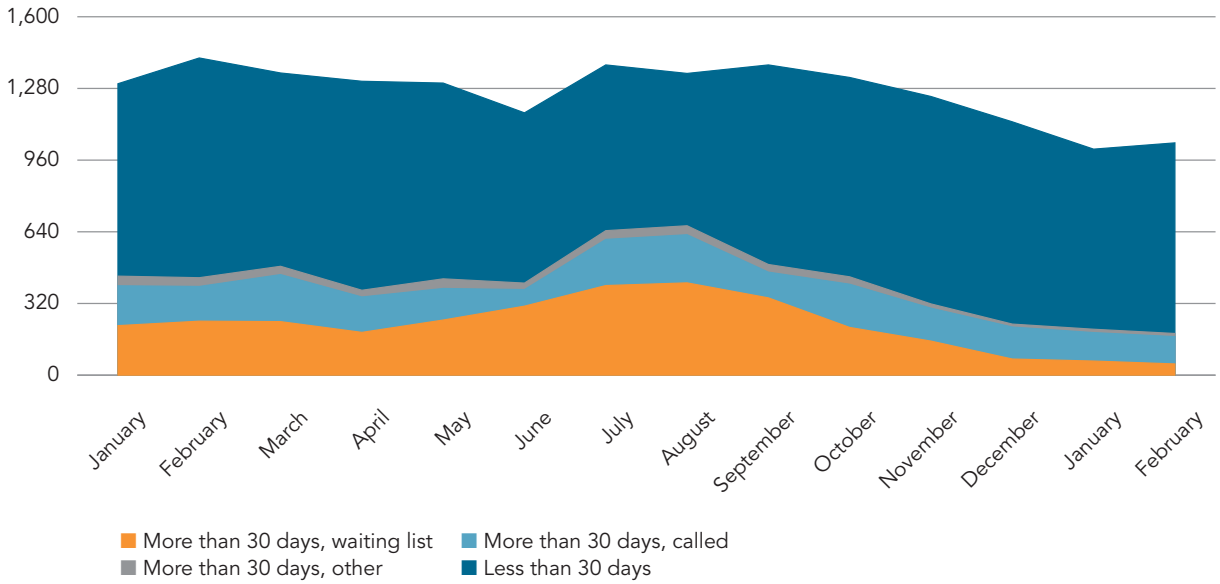
During the year, more healthcare pathways achieved the target of 80 percent of their patients receiving care on time. At the same time, we can see a slight deterioration, about 2 percent, of the total proportion who receive care on time. The median duration remains at about the same number of days compared to last year.

The focus of the work with standardised healthcare pathways during the year has been to increase the number of included patients, where the national target is 70 percent, and we have succeeded in this. We have also put a lot of work into digitising and automatically retrieving lead time data from our medical record system to follow our patients in real time and perform internal analyses.

During the year, Theme Cancer has worked actively to relieve the burden on other healthcare providers within and outside Sweden. The number of out-of-county patients has increased by over 12 percent during the year, primarily within the surgical field. During the year, Karolinska has also contributed to helping patients from Ukraine, almost half of whom have been treated at Theme Cancer.

We have managed to maintain good access to all forms of cancer treatment and we have a continued improvement in 5-year survival for cancer patients in the region.

Figure 3: Amount waiting for a new appointment (doctor) with a care guarantee.



Standardised care pathways

Figure 4: Proportion of patients within specified lead time.

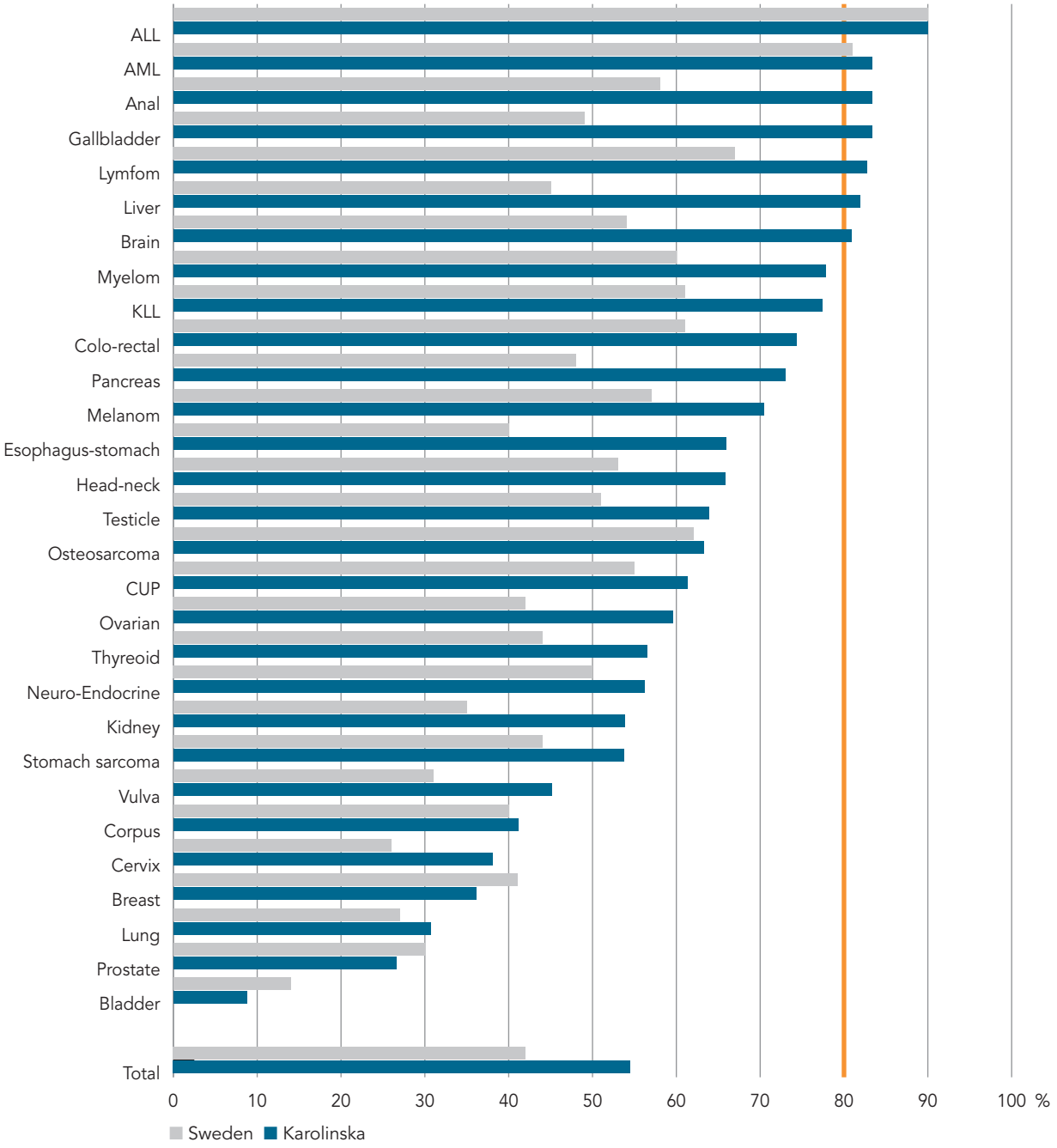
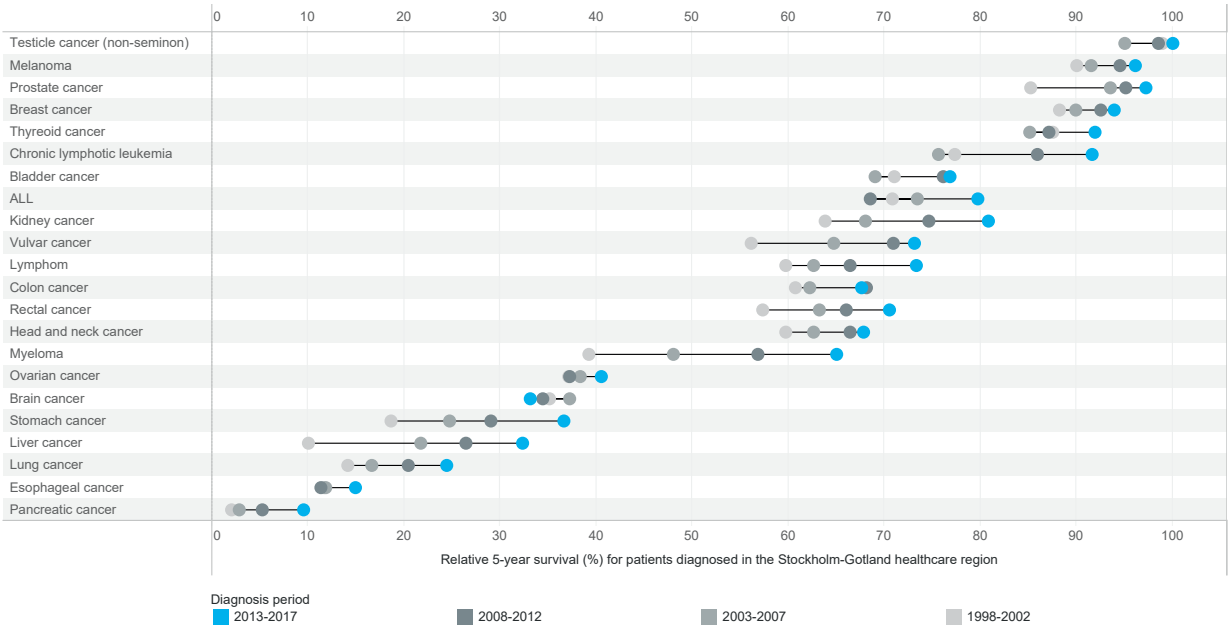


Figure 5: Relative 5-year survival, patients diagnosed (%) in the Stockholm-Gotland region.

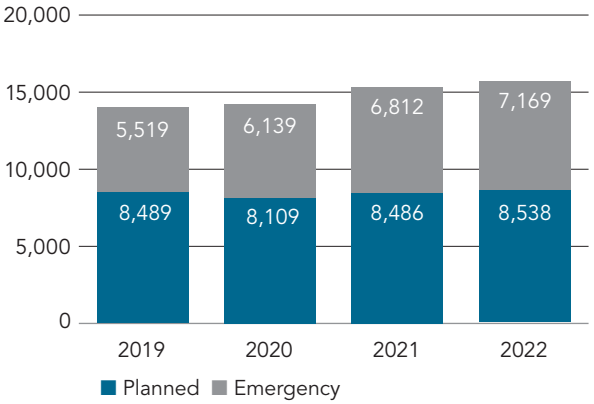


Outcomes from Medical Units (ME) Theme Cancer

Breast Cancer, Endocrine Tumours and Sarcoma

Over the past year, the organisation has worked intensively to increase accessibility for our patients by introducing several digital tools. For example, symptoms are checked before prescribing chemotherapy by sending patients a message in an app (Always Open) and asking them to answer simple questions about their well-being digitally.

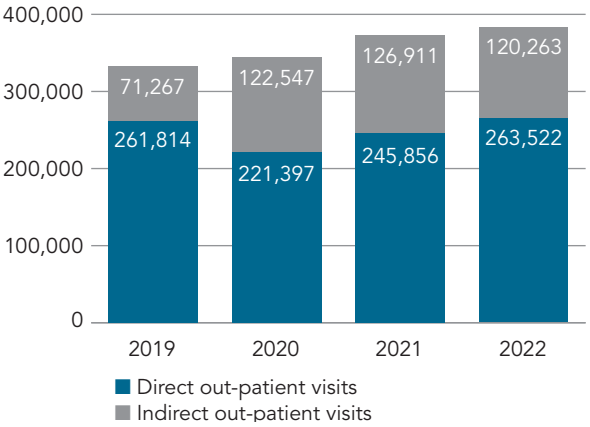
Figure 6: Number of planned and emergency admissions, 2019–2022.



Admissions	2019	2020	2021	2022
Number of admissions	14,008	14,248	15,298	15,707
Proportion of emergency admissions	39%	43%	45%	46%
Admissions with a covid diagnos	0	548	235	387
Number of hospital beds	161.7	185.2	191.2	192

Patients diagnosed with breast cancer at Karolinska CCC during the period 2008 to 2022 had significantly better 10-year survival compared to the region and the rest of the country. For the second year in a row, "Bröstknöldagen" (Breast Lump Day) was held; a day with an open, bookable clinic for patients throughout the county with symptoms from the breasts. We have participated in several research projects within both nursing and medicine that have led us to gain more knowledge within the field of exercise to counteract side effects from e.g., endocrine therapy.

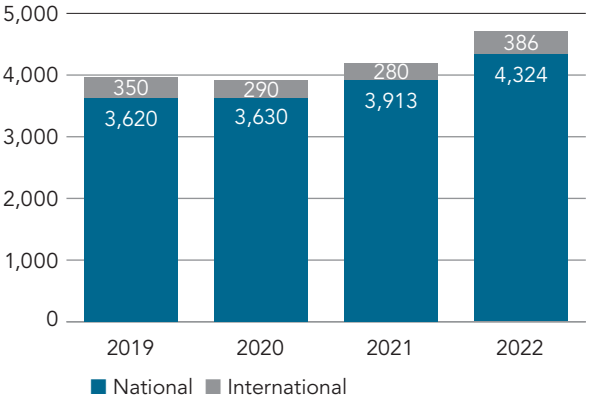
Figure 7: Number of direct and indirect out-patient visits, 2019–2022.



Out-patient visits	2019	2020	2021	2022
Proportion of indirect visits	21%	36%	34%	31%
Number of unique patients	62,327	59 431	62,597	65,558
Number of new visits	19,763	16,709	18,252	19,659
Number of unique patients diagnosed with cancer and new visits	9,065	8,524	9,088	9,844

The clinic for endocrine tumours and sarcomas has continued to streamline flows and increase accessibility by introducing a daytime on-call function where a healthcare professional, among other things, responds to internal and external requests. It has worked as a good service for external referrals, which will increase with the new NHV (National Highly Specialised Care) mission within neuroendocrine tumours and advanced adrenal diseases that will come into force in April 2023.

Figure 8: Number of national and international patients, 2019–2022.



National and international patients	2019	2020	2021	2022
Number of out-patients visits	11,776	11,840	13,182	15,133
Number of admissions	1,068	882	1,047	1,133
Multidisciplinary meetings	1,866	2,482	2,505	2,815
Number of new visits	821	617	640	936

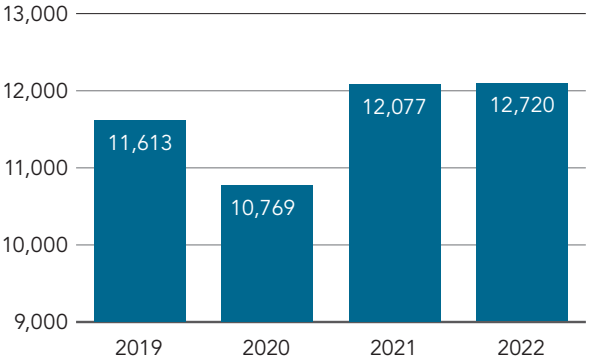
During the year, Hereditary Cancer has continued to develop the multidisciplinary conference on endocrine tumours and rare syndromes with increased cancer risks. Genetic counselling and programmes for checking for hereditary prostate cancer (male BRCA2 carriers) were initiated in October in collaboration with the Urological Cancer. The section is involved in the introduction of a fast track for direct/reflex screening of tumour tissue for genetic analysis in colorectal cancer. The section has coordinated MDT ERN-GENTURIS, a European reference network for rare tumour risk syndromes, and we also had a PhD thesis within the field.

Pelvic Cancer

In the past year, we have been awarded NHV contracts for retroperitoneal gland removal in testicular cancer, cytoreductive surgery combined with cytotoxic therapy in the peritoneal cavity, curative treatment of vulvar cancer and fertility preserving surgery in cervical cancer. The work on the different NHV applications has given us the opportunity to take an in-depth inventory of our activities and by doing this we have been able to conclude that we as a unit have a strong position within the organisation, clinic and R&D.

During the year, the Urology section has further profiled itself in the treatment of prostate cancer with modern treatment techniques. First, we have started a treatment study with focal treatment using IRE (irreversible electroporation) where men with unifocal prostate cancer are randomised to either surgery or focal treatment. Focal treatment aims to reduce the side effects of urine leakage and impotence problems that are common after surgery and radiotherapy for prostate cancer. We have also expanded the possibilities for so-called transperineal fusion biopsy, a technique which benefits patients by reducing the risk of infection after prostate biopsy. A new robotic system for prostate cancer surgery was deployed during the year. We are the tenth centre in the world with this technology that opens up new opportunities to perform advanced surgery, including for prostate cancer. The system is called HUGO Ras and in the coming years it is planned that other sections within ME Pelvic Cancer will start using it.

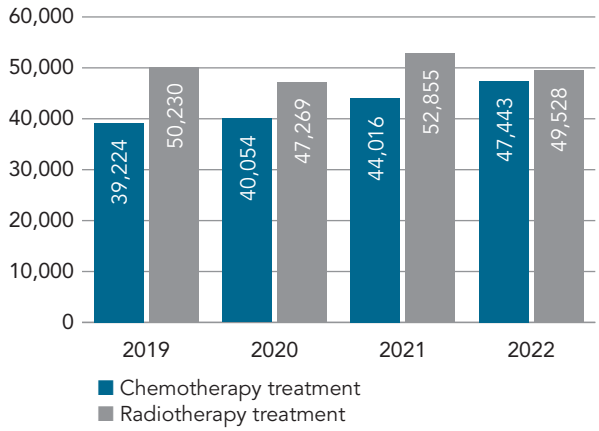
Figure 9: Number of surgical interventions, 2019–2022.



Surgery	2019	2020	2021	2022
Surgical interventions	11,613	10,769	12,077	12,720
Day surgery	3,952	3,353	3,709	3,983
Robotic surgery	918	939	1,113	1,247

In the urology oncology section, we have introduced radio-chemotherapy for muscle-invasive bladder cancer and so far 2 patients have received this treatment. After approval, adjuvant treatment with immunotherapy has been implemented in bladder cancer and also in kidney cancer. New, lower fractionated radiotherapy of the prostate has been implemented with the support of ME Radiotherapy.

Figure 10: Number of treatments, 2019–2022.

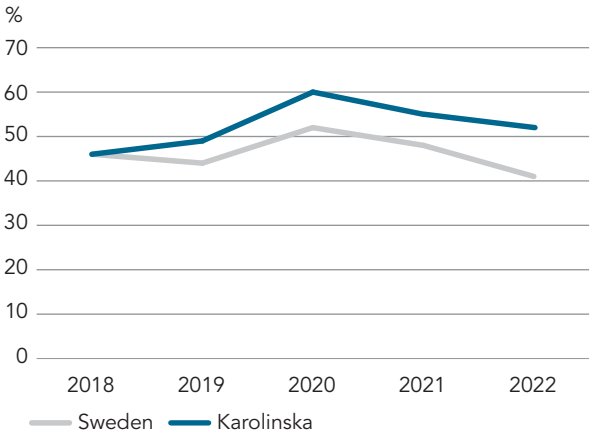


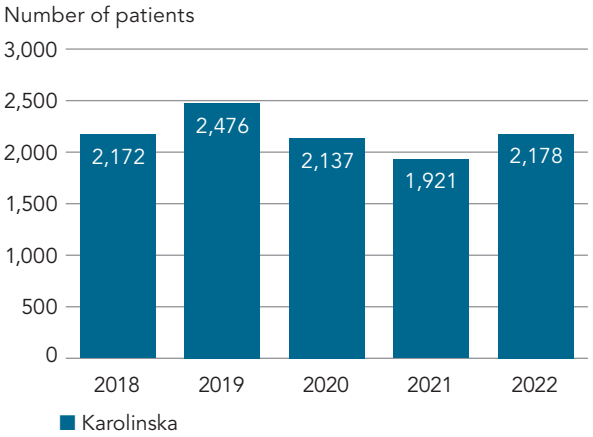
Chemotherapy/ Radiotherapy	2019	2020	2021	2022
Chemotherapy treatment				
Number of unique patients	5,148	5,446	5,824	6,254
Number of treatments	39,224	40,054	44,016	47,443
Radiotherapy treatment				
Number of unique patients	3,346	3,380	3,774	3,933
Number of treatments	50,230	47,269	52,855	49,528
Proton therapy	1,730	1,788	2,324	—

The Colorectal Cancer section has laid the groundwork for an initiative to become a world-leading section by 2025. A goal and first step towards increased sub-specialisation has been to add a new section for IBD (inflammatory bowel disease) and intestinal failure surgery. This new section will become operational in spring 2023 and an application for a national highly specialised care mission has also been completed for this area. As various new types of cancer treatments can be an underlying cause of the development of severe intestinal failure, it was assessed as urgent to start the activity. A further milestone achieved during the year has been to relaunch the Optimised Perioperative Care Program (ERAS), where high compliance of registration in the international database allows for benchmarking against other world-leading institutions.

The Section for Gynaecological Cancer Surgery has, in addition to the work with the various NHV applications, worked extensively with a 5-year evaluation of the section's membership in ERN (European Reference Network, includes rare gynaecological tumour types). These processes have highlighted the section's strengths within both clinical activities and R&D and consolidated our leading role both nationally and internationally. The section, as for the Colorectal Section, has started to optimise the processes of improved recovery after surgery (ERAS) with the aim of reducing perioperative morbidity and length of stay.

Figure 11: Proportion and number of patients starting surgical treatment within target, 2018–2022.





Finally, a project funded by the Regional Cancer Centre (RCC) was initiated to increase the proportion of patients who can undergo minimally invasive surgery, such as out-patient surgery. During the year, a lot has happened within gynaecological oncology that has had a major impact on working methods and development within the section. We have observed the results from PARP inhibitors in the treatment of ovarian cancer, with prolonged relapse times. We have, for the first time, been able to give our patients with metastatic ovarian cancer new hope that previously was not possible and hopefully we will eventually be able to see figures on increased survival rates.

Within our other major tumour groups cervical cancer and endometrial cancer, immunotherapy has finally been introduced both for primary treatment and for relapses. A gynaecology oncology research group has been established during the year, and with more research funding, we have started both epidemiological studies and large sampling studies in earnest, which will form the basis for broad preclinical and clinical research.

Celltherapy and Allogen stemcell transplantation

The year has been both challenging and rewarding for CAST. Finally, after a long pandemic-triggered waiting period, we had the JACIE re-accreditation visit just before the summer holidays. The introduction of a cell and gene therapy course for medical students led by Mattias Carlsten and Johan Törlén was a great success. We are proud that Jacek Toporski received his academic recognition as an associate professor from the University of Wroclaw. We were pleased to recruit Professor Hans Hägglund, who previously worked as Sweden's national cancer coordinator. Hans is also an expert in allogenic transplantations and connects CAST to his national and international network. Both the intermediate and primary analysis of the TRANSFORM study, where Karolinska University Hospital's first CAR T-cell patient received treatment, were published in high-ranking journals together with our international collaborators. In addition, we were pleased that our work in the COVAXID study in immunocompromised patients led to another publication, this time focusing on the T-cell response. The therapy is already available as a standard therapy in the US and Europe. Finally, we are grateful for funding from SWELIFE/VINNOVA so we are able to continue our successful work with SWECARNET.

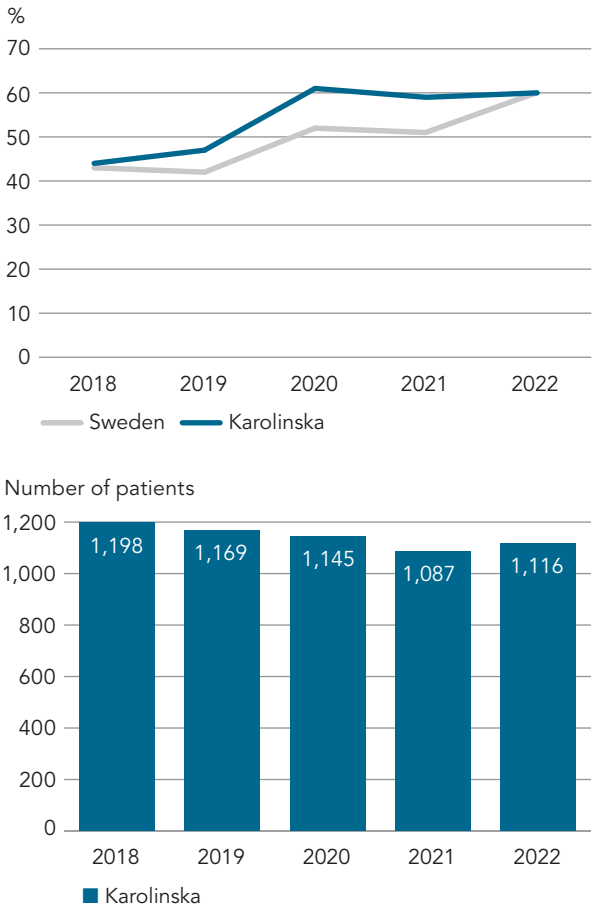
Hematology

During the year, inpatient care has succeeded in appointing Clinical Care Managers with skills requirements of a Master's degree or higher.

ME Hematology was granted funding from "Hållbara och hälsofrämjande arbetsplatser" (sustainable and health-promoting workplaces) programme to improve collaboration between professions and units in our two locations. The aim was to help making the organisation a coherent sustainable workplace. Three external speakers

were engaged and followed up with ethical group discussions. In addition, each unit used one day to improve sustainable activities within their relevant unit. Our inpatient departments have been monitoring food waste throughout the year. Each unit, as well as the liaison and management team, has introduced a standing environmental item on its agenda. A 25 percent reduction in the use of disposable kidney dishes was achieved, as well as reducing the disposal of medicines by 25 percent.

Figure 12: Proportion of patients starting oncological treatment within target, 2018–2022.



During the year, the Lymphoma Section has focused on increasing the number of open clinical studies with a focus on early trials and academic studies. The section has treated the most patients in Sweden with bispecific antibodies that utilise the body's immune system to treat refractory lymphomas in both phase 1, phase 2 and phase 3 studies. Within diagnostics, the inclusion of all new lymphoma patients in the BioLymph study continues, where we also perform precision medicine analyses with broad panel sequencing for all patients. New chemotherapy-free treatment regimens have been introduced in the national care programme as first-line treatment options for chronic lymphocytic leukaemia (CLL).

The bone marrow failure and leukaemia section has also increased the number of open clinical studies. Projects for home administration of medicines are now more extensively established. Several staff members have contributed to the new international MDS risk assessment.

The Myeloma Section has focused on continuing to conduct a wide range of clinical studies with many new medicinal products in phase 1 and phase 2 for treatment-refractory patients. This means that the section today has the national lead in the knowledge of treating myeloma patients with bispecific antibodies in current phase 3 studies. During the year, monoclonal antibodies and non-cytotoxic tablet therapies have gained a significant role already at the beginning of the treatment process according to national guidelines.

Continuous structured work with our flows has enabled us to meet lead times for SVF for lymphoma, CLL, AML, myeloma and ALL. In addition, a new SVF has been implemented at the end of the year for myeloproliferative neoplasia.

The Coagulation Section has focused on various development projects. A significant change and development in the field of haemophilia was the TLV approval of Emicizumab (Hemlibra) for patients with severe haemophilia A, which will prevent many late complications and thus also increase the level of activity and quality of life in these patients. The possibility of starting treatment with gene therapy for haemophilia A as soon as the medicine is approved exists. Precision medicine with a haematology gene panel is established and has led to international collaboration in rare types of thrombophilia.

Head, Neck, Lung and Skin Cancer

The Pulmonary Oncology Centre has introduced weekly training for all staff on current topics including information on current studies and projects, results, treatments and diagnostics. We also have regular lectures and seminars for doctors and nurses by invited internationally recognised doctors and researchers. We organize regular R&D days with presentations, discussions and networking between doctors and nurses and preclinical researchers to increase research collaborations between the hospital and academia. We are also planning a first "FOU-fika" (R&D coffee morning) where we drink coffee, talk, and provide feedback on the results of studies conducted in our many diagnostic groups.

A multidisciplinary clinical study involving doctors and nurses representing "team science" has been launched in lung cancer with patient-reported symptoms (LUCAS) after first-line treatment of advanced/locally advanced lung cancer. The number of clinical studies continues to increase at ME HHLH.

The lung cancer screening, a pilot project through the RCC, has started, and the first patients started arriving at the end of the year for evaluation.

Psycho-oncology Clinic

At the Psycho-oncology Clinic, this year we have invested even more in group activities for patients and relations within Theme Cancer and we receive excellent evaluations of it. We have also started using Metacognitive Therapy to reduce anxiety in patients with complex anxiety problems and are evaluating this through validated assessments. The evaluation revealed that out of the seven participating patients involved, all experienced a clinically significant anxiety after the therapy.

The follow-up clinic for adults treated for cancer was moved from the Centre for Cancer Rehabilitation to Theme Cancer in January 2022, and we have recruited new staff and started activities. This unit also involves increased collaboration with Paediatric Oncology.

Medical Treatments

As of 1 January, the medical treatment departments are organised under a common medical unit, ME MBA. The purpose of the reorganisation is to ensure equal working methods and routines and ensure greater accessibility for all patients and thus more equal care.

The departments have been located in Solna and Huddinge to create a centralisation of human resources and thus there is no division according to diagnosis per unit. The purpose of not having a diagnostic classification is to ensure equal care for patients and a more even workload for staff. In order to enable this approach, experienced nurses have switched jobs to supervise their colleagues and maintain skills. This means that there is competence to deal with all of the theme's medical treatments within each department.

To optimise treatment places and increase accessibility, departments have extended their opening hours. Several patient groups who are working professionals have appreciated being able to arrive in the evening to receive their treatment.

The departments have an equal structure for a smoother workflow, and during the year, a working tool has been developed, MBA Overview. This has resulted in a changed and more efficient work flow when ordering cytotoxic treatments.

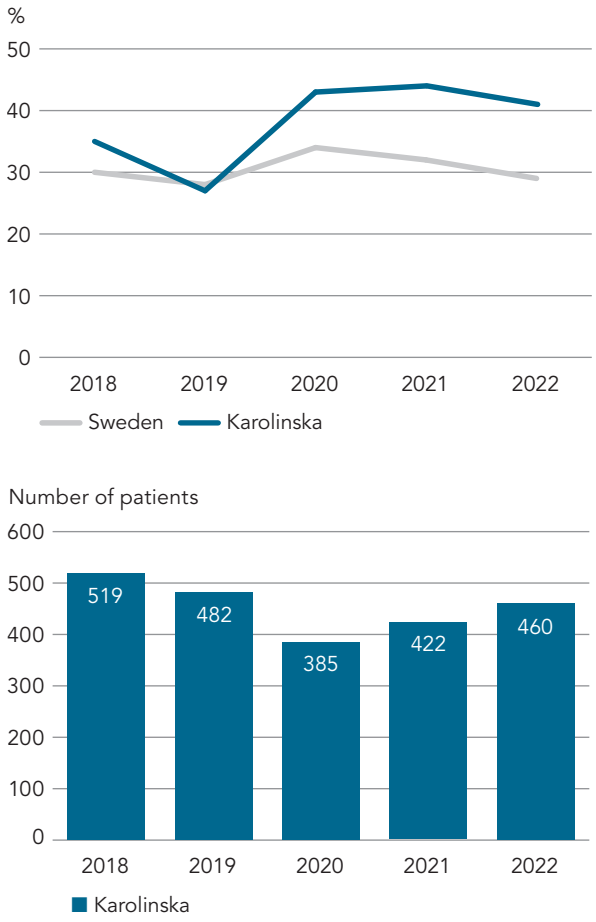
During the year, digital symptom checks have been introduced for a number of patient groups. This means that patients receive a text message on their mobile phone to report symptoms two days before their medical treatment via an "Always Open" app. The implementation and results of the patient experience were presented in a poster exhibition at the EONS/ESMO conference in Paris in September.

Karolina Fridblom, Operation Manager, Nursing Area 3

In conjunction with the introduction of digital symptom checking, electronic notifications were also introduced. This has led to a more efficient way of working and has enabled patients to ask follow-up questions via a chat function. A special effort has been made for patients with remaining venous access ports as waiting lists have formed during the pandemic. One hundred patients have had their venous access ports removed during the autumn and for many patients this has meant an "end" to their cancer journey and thus been very appreciated.

A work environment initiative has been implemented in the form of swab tests for the detection of cytotoxic medicines. Presenting the results has led to improvement initiatives in terms of cleaning, the use of protective equipment and handling of medicines. This work was also presented at EONS/ESMO conference in Paris. This has also led to the dissemination of knowledge within the National Network for cytostatic medicines in Sweden.

Figure 13: Proportion and number of patients starting radiotherapy within target, 2018–2022.



In order to better monitor pharmaceutical costs and scale the departments according to needs a digital overview has been created. We are now in the implementation phase and in 2023 we will have more knowledge of how the tool can be developed and used.

Work on procedures and practices will continue in 2023 and three Clinical Care Managers have been appointed to support the development of the activities in cooperation with the Nurse Manager and the managers. To clarify objectives and competence development, the region's competence ladder has been developed with specific areas that are important for MBA's activities and employees. In 2023, the competence ladder will be implemented and developed further.

Radiotherapy

ME Radiotherapy has worked on the following initiatives during the year:

- We have introduced hypofractionated breast and prostate treatments, for the prostate using the so-called tracking technology, where the radiotherapy is stopped if the prostate is outside the beam area.
- We have also introduced MRI-only treatment for brain tumours and started a clinic for benign brain tumours that may require radiotherapy.
- Gynaecological cancer patients no longer need to get tattoo marks but can be positioned using surface scanning.
- Again this year, we have focused on increasing the number of patients in clinical studies.

After several years of intensive improvement work towards a paperless radiotherapy workflow, we are now pioneering this process in Europe. Carina Holmberg presented our approach at the European Radiotherapy Conference (ESTRO). Knowledge sharing will continue internationally in 2023.

In the first quarter, we started using digital notifications for our patients. This makes it easier for our patients to receive real-time notifications with a chat function to reach us in case of questions.

Based on an employee initiative, we have also created a digital form for patients who are about to undergo a radiation preparatory dose planning MRI, they answer safety questions in the "Always Open" application. These initiatives have increased accessibility for our patients, but have also had a positive environmental impact, such as reducing carbon dioxide emissions in Region Stockholm.

Together with the Cancerfonden (Swedish Cancer Society), the nursing group has made a film about how breathing-guided radiotherapy can be carried out. The aim is to allow the patient to be prepared prior to their planned radiotherapy. The film is available for everyone to watch on our relevant websites.

Upper Abdomen

At the turn of the year, the oncology sections of Theme Cancer were established, and as a result, all gastrointestinal oncology was gathered under ME Upper Abdomen. We are convinced that it will strengthen the oncology and further improve care for our cancer patients.

Robotic surgery within the Upper Abdomen division continued to evolve, and evaluation of the effects for patients who underwent liver and pancreatic surgery with this technology included shorter length of stay, less bleeding, no need for epidural anaesthesia and reduced need for intermediate care and rehabilitation clinics compared with open surgery. Continued evaluation of clinical outcomes and research in robot-assisted technologies for these patients is ongoing.

We have operated on patients with upper abdominal cancers from three other university hospitals in Sweden that have had a lack of capacity, resulting in long waiting times for surgery. Karolinska CCC should be the entire country's resource when patients with cancer need timely surgery, and we are proud to be able to contribute to this.

In terms of training, it should be highlighted that student teams have been set up in several inpatient departments. Because of this, several nursing students have shown great interest in returning to work within the organisation after graduation. Finally, ME Upper Abdomen has successfully established a nurse fellowship within ERCP (an endoscopic procedure) and an international fellowship in liver and pancreatic surgery.

Healthcare management – Theme Cancer

During the year, Theme Cancer has worked extensively on documenting quality and the procedures around registration of care. The activities are facing a number of challenges, with a clear trend of more patient appointments are carried out digitally. Within healthcare administration, a task force has been set up to support the work with remote contacts.

We have identified several areas for improvement, and training has been conducted with doctors and medical secretaries on coding cancer care. Documentation quality is now markedly improved and in 2023 the work will continue under the leadership of a new DRG controller.

Our employees

Karolinska CCC is a leader in the development of several areas and many employees are doing excellent work. Together, we have contributed to the Hospital being named the seventh best hospital in the world by Newsweek magazine. We offer skills and career development for all employees. Several options are available to stimulate development and research within healthcare. We share and gain knowledge from around the world. The aim is to integrate academic healthcare development into the whole organisation.

HR (Human Resourses) Theme Cancer

Compared to a year ago, Theme Cancer has a positive inflow of skills.

Employee survey 2022 Theme Cancer

The metric of employee experience, eNPS, i.e., Employee Not Promoter Score, has improved significantly for Theme Cancer, from -5.6 in 2021 to +1.4 in 2022. This means that Theme Cancer stands out in the number of employees who would recommend Karolinska University Hospital as an employer, compared to the hospital average.

Theme Cancer maintains good results in the Employee Survey in comparison with the entire Karolinska University Hospital. Theme Cancer is above average in all performance points.

Karolinska Institutet

Over 360 cancer principal investigators have been identified at KI and are listed and their research described in the Cancer Research KI database. The predominant cancer research areas at KI are pre-clinical research, blood cancer, brain and nervous system cancer, cancer epidemiology and breast cancer. The Department of Oncology and Pathology has the highest number of group leaders within the field of cancer research at KI.

Figure 14: Theme Cancer has a positive inflow of skills.

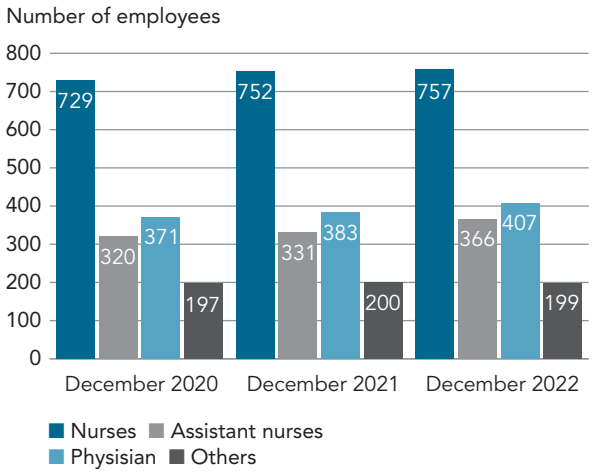


Figure 15: Result from the employee survey, 2021–2022.

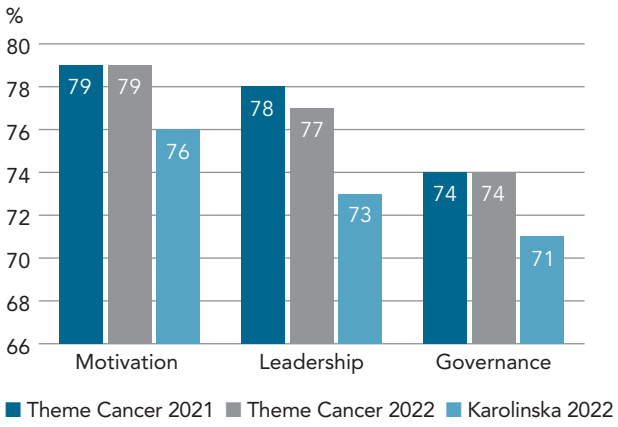


Figure 16: Theme Cancer has a positive trend regarding employee retention beyond 2 years.

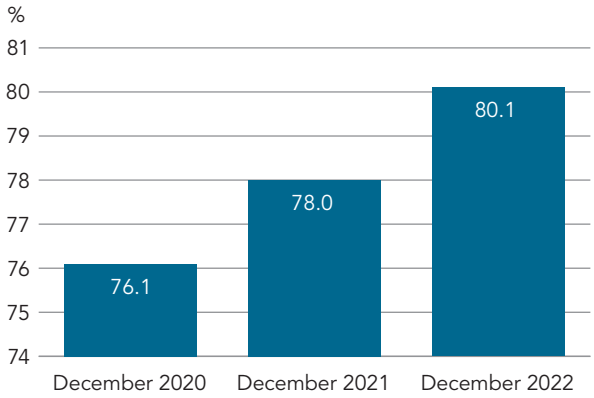


Figure 17: Number of principal investigators per cancer research area at KI.

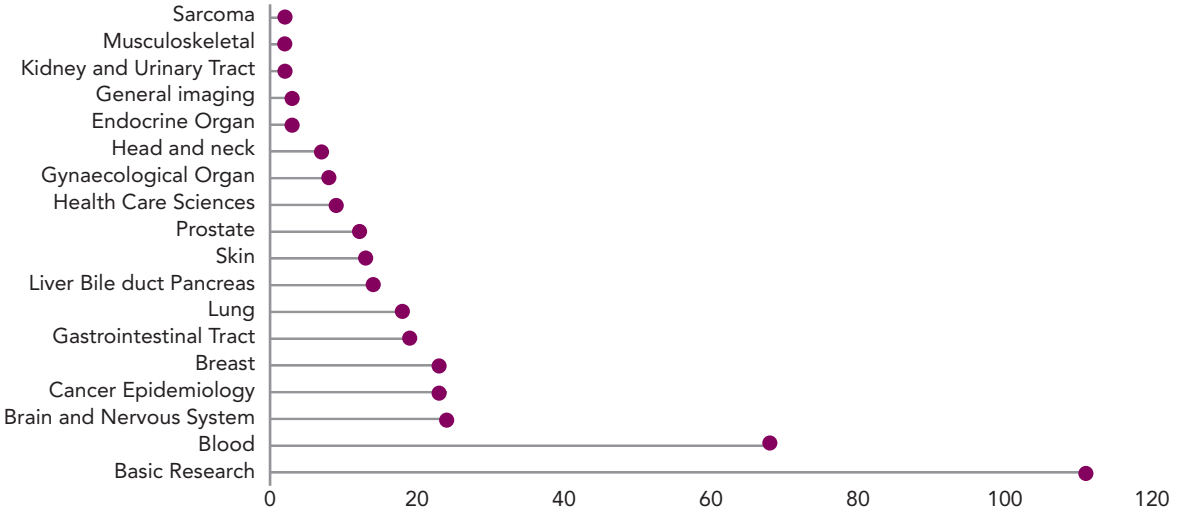
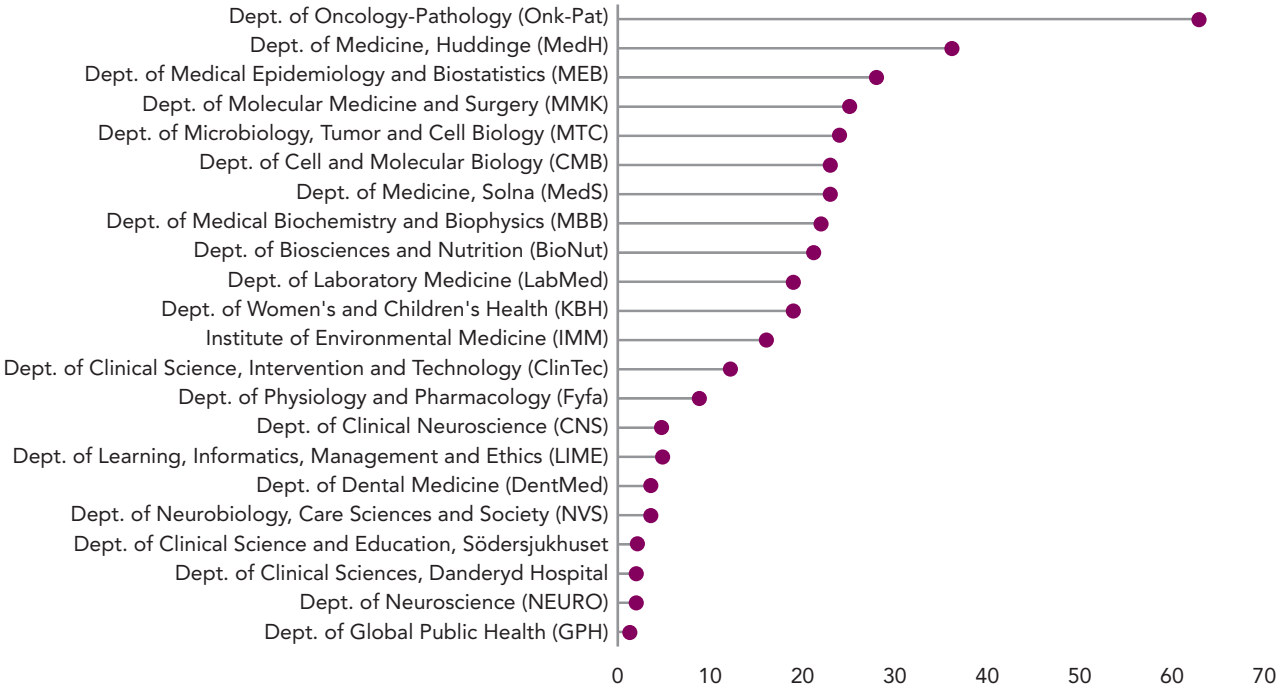


Figure 18: Number of principal investigators within the cancer area per KI department.



Awards within the cancer field

Mattias Rantalainen, Fredrik Wetterhall and Johan Hartman

Mattias Rantalainen, Fredrik Wetterhall and **Johan Hartman** received the Athena Award on 25 October for AI-based precision medical imaging analysis for risk classification of breast cancer patients. The Athena Award is Sweden's largest prize for research and innovation developed through collaboration between healthcare, academia and industry. The nomination is For the development of an AI-based decision support tool for prognostic analysis of breast cancer directly from microscopy images. A tool that can bring significant benefits to both healthcare and patients by enabling cost-effective and equivalent precision medicine diagnostics throughout the country. This is an impressive piece of work where researchers have gone all the way from basic academic research through diligent footwork with training in advanced AI models in the pathology lab, to the first approval for clinical use. Many partners from academia, healthcare and the industry have collaborated in the work, which is now moving forward with the development of AI-based methods for imaging diagnostics for all major tumour groups.

Karolinska CCC celebrated Cancer Nurses' Day on 18 May. This year's theme was practice-based peer learning. Nearly fifty nurses attended this year's programme, which was held in both Huddinge and Solna, with lectures and also the presentation of the international Daisy Award 2022. The Daisy Award is presented for excellent nursing care, something that Theme Cancer is the only organisation in Sweden to nominate and award. Out of a total of 38 nominations received from patients, this year's award went to **Rebecca Moborn**.

Tobias Nordström has been awarded the European Association of Urology (EAU) "Prostate Cancer Research Award 2022" for the Stockholm3 test.

Richard Rosenquist Brandell was named Cancer Networker of the Year by the Network Against Cancer.

Mathias von Beckerath was awarded the Supervisor of the Year Award from the Stockholm Medical Association.

Klara Arvidsson was awarded for Exemplary Collaboration within Theme Cancer.
She works as a Clinical Care Supervisor.

Henrik Grönberg has been nominated by the Cancer Foundation's Research Committee as Cancer Researcher of the Year. For world-leading prostate cancer research. For methods to detect prostate cancer at an early stage, but also to avoid unnecessary investigations, and to identify those patients who need to be treated immediately. All this contributes to more personalised treatment, increased chances of cure and a high quality of life.

Josefin Fernebro was awarded the 2022 Fire Hero Award by the Network Against Gynaecological Cancer.

For their efforts to create better and more patient-focused lung cancer care, **Vitali Grozman** and **Sven Nyrén** were named Recipients of the Lung Cancer Grant of the Year. This was celebrated on 10 November at the Lung Cancer Day, organised for the 19th time by the Lung Cancer Society.

Annika Sjövall received the Intestinal Cancer Grant from the patient association ILCO on 30 March.

Klara Arvidsson

Quality monitoring

Theme Cancer's definition of quality is to meet, and preferably exceed, the needs and expectations of our patients, clients and employees' needs and expectations.

Patient satisfaction

The aim of the survey is to obtain more information about the patients' experience of the healthcare; treatment from healthcare staff, participation in decisions to the desired extent and whether the information provided has been sufficient. In 2022, the number of surveys sent out has been automated and this has resulted in an increased number of responses.

In addition to treatment, participation has been a parameter we have focused on, the results are slightly better but differ between theme activities. In 2023, the ambition is for all activities to reach the target value.

Area	2020	2021	2022	Target
Professional approach	91%	85%	87%	87%
Participation	92%	85%	86%	85%
Information	94%	92%	95%	90%
Number of respondents	5,996	2,424	18,628	—

Nursing

Assessing patients' risk of malnutrition, pressure ulcers and falls is an important step in working with patient safety. From 2021, these indicators will be measured continuously. The information is retrieved directly from the medical record system and based on that documentation, the results report is digital and accessible to all.

Nutrition

The purpose of monitoring is to ensure that good care is provided by early identification of patients at risk of malnutrition.

In 2022, the proportion of patients assessed as at risk exceeds the target level, but as this is a risk factor for about half of the patients, results need to be further improved. An improvement project has therefore been initiated through the Quality Council.

Area	2020	2021	2022	Target
Complete nutritional assessment	74%	71%	74%	70%
Percentage of patients with risk factors	52%	52%	51%	—
Percentage of patients at risk with prescribed measures	65%	77%	77%	90%
Number of respondents	598	8,952	9,367	—

Pressure ulcers

The purpose of the monitoring is to ensure that good care is provided by preventing and reducing the incidence of pressure ulcers.

The results show that more patients in inpatient care have been risk assessed compared to the previous year, the results are moving in the right direction. The proportion of at-risk patients with prescribed measures continues to increase.

Area	2020	2021	2022	Target
Percentage of patients assessed at risk for pressure ulcers on admission	96%	77 %	82%	80%
Percentage of patients with acquired pressure ulcers, categories 2–4	3.8%	—	0.5%	3%
Percentage of patients at risk with prescribed measures	50%	56%	66%	60%
Number of respondents	180	8,952	9,438	—

Falling

The purpose of monitoring is to ensure that good care is provided by identifying patients at risk of falling early during their stay and taking preventive measures.

The survey shows that the number of risk assessments has increased compared to the previous year and that more patients with identified fall risks are prescribed preventive measures.

Area	2020	2021	2022	Target
Percentage of patients assessed at risk for falls on admission	95%	78%	82%	70%
Percentage of patients at risk of falling with fall prevention measures prescribed within 24h	40%	56 %	69 %	65%
Number of respondents	98*	8,952	9,367	—

* few measurements in relation to no measurements during the COVID pandemic

Healthcare-associated infections and hygiene

Healthcare-associated infections (HCAI)

The primary purpose of the follow-ups is to serve as a basis for the improvement work carried out in each department within Theme Cancer to reduce the proportion of patients affected by HCAI.

HRI outcomes within Theme Cancer are high for a number of reasons, including treatments that cause immune suppression, patients who are already susceptible to infection, and extensive surgical procedures.

In 2022, Theme Cancer has participated in a project for data-driven information management and visualisation of healthcare-associated infections. The work has mainly involved ensuring that the input data has been correct. In 2023, work will continue with the aim of generating reports showing the proportion of patients with HCAI, the proportion of catheterised patients, commonly used antibiotics, and the number of days an indwelling catheter (KAD) and a central venous catheter (CVC) remain in place.

Basic hygiene and dress code

This survey is an observational study that all units carry out every month. Even in 2022, we see some deterioration in all areas.

Common and activity-specific activities need to be identified to improve this result in 2023.

Area	2020	2021	2022	Target
Disinfection before and after, gloves and protective clothing used correctly	75%	74%	73%	—
Outfit, rings, nails, and hair were used correctly	94%	93%	92%	—
All 8 sub-elements correctly performed	72%	70%	68%	71%
Number of observations	2,049	1,777	2,260	—

Resistant bacteria with notification duty

Survey of the proportion of hospitalised patients at increased risk of MRSA where complete MRSA cultures are taken on admission. Monitoring is done through point prevalence measurements twice a year.

The results show that we are not achieving the objectives at the thematic level. A new digital real-time board for visualising results will help organisations to see which patients have been risk assessed.

The goal is that at each morning meeting, the healthcare staff looks at this real-time board where it is visualised which parameters are not implemented, making it easier to do things correctly.

Area	2020	2021	2022	Target
Patients with proper management according to healthcare program	66%	72%	59%	90%
Number of observations	77*	150	425	—

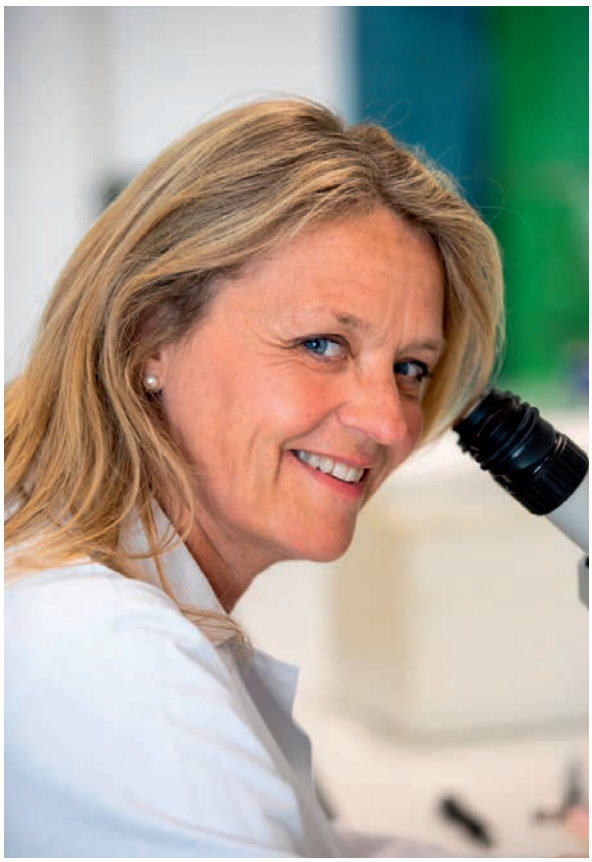
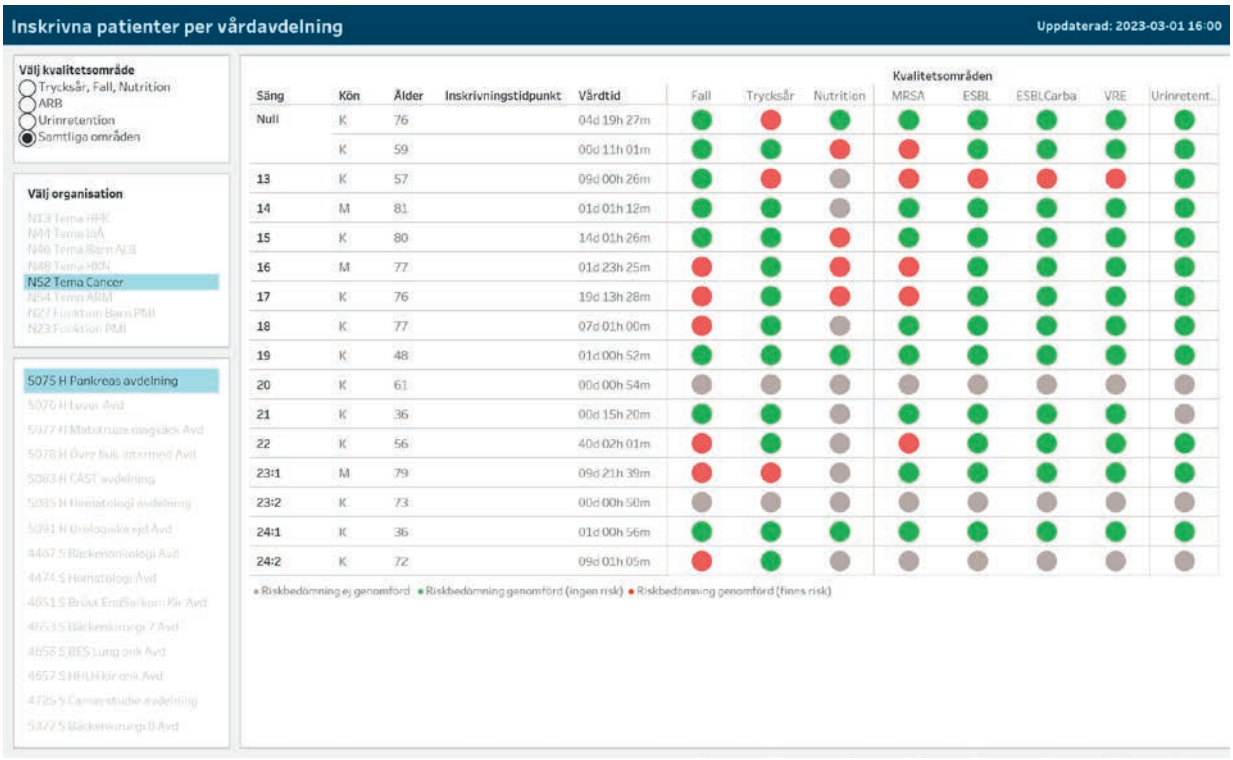


Figure 20: Image of a digital real-time board.



Patient safety work

In the spring of 2022, the Head Physicians, together with the Hospital Director, conducted a patient safety dialogue with the theme management. The aim of the dialogue is to ensure a good patient safety culture where we can highlight risks and incidents to prevent healthcare injuries.

The structure of the dialogue is based on the national action plan "Agera för säker vård" (Acting for safe care), which reviews the basic conditions for safe healthcare and examines prioritised focus areas.

During the autumn, these dialogues have continued at director level and most of the theme's management groups have had their own dialogues with the Head Physicians on patient safety work.

Environment

Environmental issues have been a focus for many years and Theme Cancer complies with the hospital's ISO 14001 environmental standard. With the help of the certified environmental management system, the operations work daily to reduce environmental and climate impact, and together with the hospital strive for lasting improvements. Our environmental and sustainability information officers support colleagues and management in local environmental work.

Sustainability initiatives at Theme Cancer

The *green ward* concept is a development effort that involves everyone working in the ward and involves working proactively to reduce environmental impact. The starting point is Karolinska's environmental policy and sustainability programme and is coordinated by the environmental coordinator. Evaluation of environmental impacts and monitoring of continuous improvement actions are carried out by the department based on identifying objectives and activities and through an awareness to always choose the most environmentally friendly option based on evidence and to consider resource efficiency. Areas identified are energy, material selection, pharmaceuticals, waste.

Research and education

Karolinska CCC has continued to implement a wide range of training activities throughout the year. We have retained and often combine this form of training with a digital option, which increases accessibility to participate in training for our staff. During the year, our training mission has resulted in a total of 5,783 student weeks for students in all our professional categories. There is a need to increase the number of supervisors for nurses and the supervisor training course is offered to our employees.

Internal training – some examples

Theme Cancer introduction days have been carried out as planned on two occasions of two days per occasion and is carried out at both sites. Course leaders are Jenny Rundgren and May-Len Ström. The aim is to provide basic knowledge in cancer care and training courses are aimed at newly recruited staff from nursing and healthcare professions. On the training sessions during the year 65 newly recruited employees attended each session.

During the year, Theme Cancer's nurses have carried out 5 journal clubs, led by Jeanette Winterling. An academic forum where selected publications are read in advance and then discussed in a group setting in the forum. Examples of topics addressed were: *What are the experience of patients, their partners, and the nurses of sexual health? What are common side effects after radiation? Does ice work for neuropathy? How do I support the underage children of parents who have taken cancer? How does living with an increased risk of bowel cancer affect life – as in Lynch syndrome?*

During the year, the teaching of cancer screening and treatment to undergraduate doctors continued to be developed. New educational models such as team-based learning (TBL) are explored to make teaching more effective for a larger number of students. This is implemented in particular when students are studying evidence-based medicine, and teaches students how to critically examine the scientific basis for clinical decisions. This type of training will continue to be used for the transition to the 6-year medical programme where the first course in cancer and palliative medicine will run in 2026. Furthermore, there is already a strong emphasis on the teaching of individualized cancer treatment and precision medicine.

As the proportion of patients increase with this type of treatments, examinees should have knowledge of the constant evolution of cancer treatment. Thus, an in-depth course is offered in multidisciplinary cancer treatment for medical students in semester 11 to offer a deeper understanding of how decisions are made about cancer treatment and the individual adaptation that is possible for each individual patient.

Karolinska Clinical Cancer Talks has conducted several interesting and rewarding lecture series during the year. The people responsible for these talks are Olof Akre, Stephan Mielke and Jonas Bergh. Both own researchers and internationally invited guest speakers have presented current medical cancer research within cancer biology, oncology, and cancer surgery.

Karolinska Clinical Cancer Nursing Talks started in the autumn of 2022 and two talks were held, led by Berit Sunde. The topics covered were: whether shared decision-making is possible, examples from bowel screening and the life situation of patients who had an allogeneic stem cell transplant, and their relations. The plan going forward is to have two talks per semester.

The MTB (molecular tumour board) is now an established and regular training forum and during the year 18 events were held and moderated by the Centre for Clinical Cancer Studies. Jeffery Yachnin teaches interesting cases from the various molecular diagnostics projects.

During the year, the Oncology Education Forum has covered a variety of topics and the highlight was Professor Stefan Einhorn's closing lecture, "Om cancer, Gud, livets mening och allt det andra" (On cancer, God, the meaning of life and all the rest).

Workshop for Principal Investigators has been organised by the Centre for Clinical Studies, CKC. The training is aimed at both those who are responsible investigators today or are interested in becoming that. The content focuses on discussions and training on what the investigator role entails.

During the year, a basic course for research nurses was offered in collaboration between Karolinska Trial Alliance, Cancer Study Unit at Karolinska Institutet, CCC and Forum Stockholm-Gotland (part of the Clinical Studies Sweden). The aim of the course is to provide a practical, holistic approach to the role and responsibilities of research nurses in all moments of the clinical study. You will learn more about screening and inclusion of study participants, responsibilities, sample management, and how to read a study protocol.

Clinical studies

This year, Theme Cancer has also included more patients in our studies than in previous years, which we overall are very proud of. We have also more studies than previously ongoing within our Theme. 70 new studies were launched and 2,504 patients are included in clinical studies. In total, we have 405 ongoing studies.

Research projects – a selection

Karolinska Institutet is one of the world's top-ranked universities and plays a central role in research within areas such as cancer and haematology. In Sweden, KI is responsible for the single largest share of medical research, with 2,000 PhD students and research spanning the entire biomedical field. Of the large number of projects carried out at the KI, a small selection is presented below.

Digital accuracy with AI

The rapid development of AI-based modelling within pathology has made it possible to see and quantify tissue samples based on patterns that the human eye cannot detect. KI researchers realised early on that the future of pathology is digital. Together, they have developed an AI-based decision support tool that improves the diagnosis of breast cancer tumours and the ability to predict the relapse risk. For this, their product Stratipath was awarded the 2022 Athena Award, Sweden's largest award for research and innovation.

Publication: Improved breast cancer histological grading using deep learning. pubmed.ncbi.nlm.nih.gov/34756513

Figure 21: Number of patients included , 2019–2022. The number of patients included in studies increased by 18% compared to 2021.

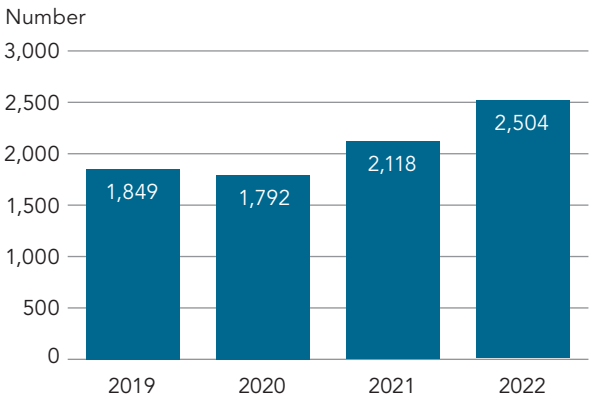


Figure 22: Proportion of newly diagnosed cancer patients included in studies, 2019–2022.

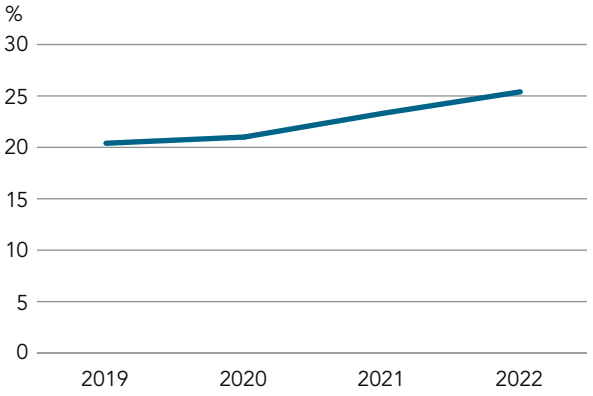
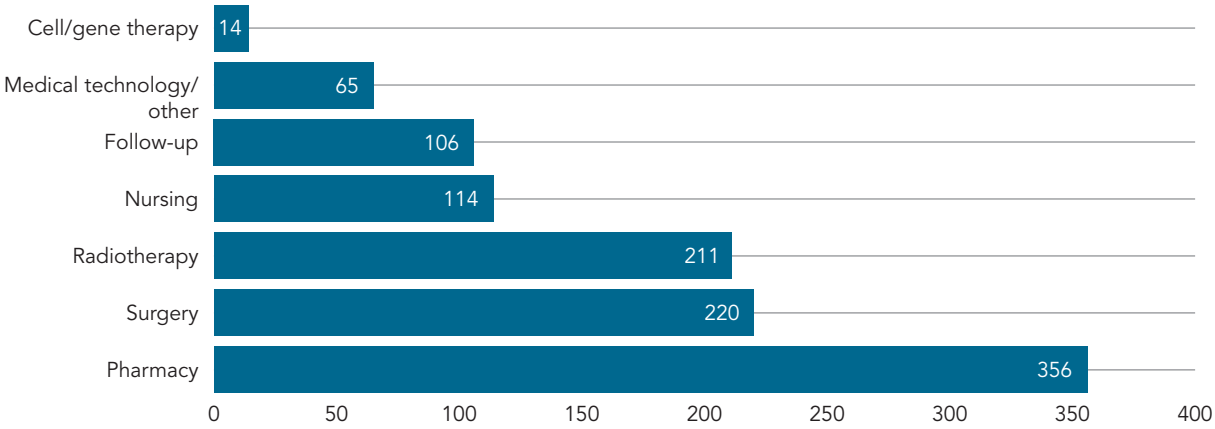


Table 1: Trials open for inclusion 31 December 2022.

	Theme Cancer	Breast Cancer, Endocrine Tumours and Sarcoma	Pelvic Cancer	Phase 1-unit	Hema-tology	Head, Neck, Lung and Skin Cancer	Radio-therapy	Upper Abdominal
Trials started in 2022 (2021: 68)	**70**	10	11	8	12	9	2	12
Ongoing trails 31 Dec 2022	**405**	50	79	31	93	63	6	65
Trials open for inclusion	**187**	16	34	23	38	22	6	37
Proportion of academic trials	**57%**	63%	62%	22%	47%	68%	83%	78%

Figure 23: Number included in studies 2022.



AI is also an accurate method for diagnosing prostate cancer. Here, objective assessments of tissue samples are a challenge, which has led pathologists to come to different conclusions despite studying the same samples. A research team at KI has now shown in a study that AI technology can be used to improve the assessment of tissue samples so that they match more closely, regardless of the pathologist who performed it.

Publication: Artificial Intelligence for Diagnosis and Gleason Grading of Prostate Cancer: the PANDA challenge. www.nature.com/articles/s41591-021-01620-2

Development of multicancer tests

A growing area of research is to find effective methods for the early detection of several types of cancer simultaneously, so-called multicancer tests. Today's established screening methods are DNA-based and limited to a few cancer types, which means that patients need to undergo a separate test for each cancer type. Here, a group of researchers at Chalmers and KI have presented a study of a cancer test based on human metabolism instead of DNA. These multi-cancer tests, which are done via blood or urine tests, can detect several types of new cancer at the same time - even cancers that are difficult to detect by other means. The tests are both simple and cost-effective, which would allow more patients to take advantage of them. The discovery has resulted in the launch of the diagnostics company Elypta.

Publication: Non-invasive multi-cancer early detection using glycosaminoglycans. www.pnas.org/doi/full/10.1073/pnas.2115328119

Another screening test developed by researchers at Karolinska Institutet can detect the risk of not only cervical cancer, but also breast and ovarian cancer via a single cervical cell sample. The test can also predict cell changes long before they are visible under a microscope. This so-called WID-CIN test analyses the changes in cells that affect which genes are active.

Publications: The WID-CIN test identifies women with, and at risk of, cervical intraepithelial neoplasia grade 3 and invasive cervical cancer. www.nature.com/articles/s41467-021-27918-w

The DNA methylome of cervical cells can predict the presence of ovarian cancer. www.nature.com/articles/s41467-021-26615-y

Room temperature affects growth rate

New evidence also shows that low room temperatures seem to make it harder for cancer cells to grow. In a study carried out with mice by researchers at KI, mice living at a temperature of 4 degrees Celsius had significantly slower tumour growth compared to mice living at a room temperature of 30 degrees Celsius. This is due to the activation of brown adipose tissue at low temperatures, the type of fat in the body that converts energy into heat to maintain a constant body temperature. The brown fat absorbs the sugar that cancer cells need to grow, which in turn inhibits tumour growth. Similar results were also observed in people with cancer.

The results suggest that exposure to cold may be a novel approach to cancer therapy, but larger clinical studies are needed. The study also found that a high intake of sugary drinks in mice reduced the beneficial effect of low temperatures, suggesting that a limited supply of glucose is an important method for inhibiting tumour growth.

Publication: Brown-fat-mediated tumour suppression by cold-altered global metabolism. www.nature.com/articles/s41586-022-05030-3

Research grants

Every year, Karolinska Institutet is awarded large grants to be able to conduct and develop cancer research. Among the largest donors are the national organisations Cancerfonden (The Swedish Cancer Society) and Barncancerfonden (The Swedish Childhood Cancer Fund).

Cancerfonden makes calls for proposals both in autumn and spring, where the selection process means that all research projects within the field compete with each other. The projects considered to have the greatest potential to achieve successful results are then selected.

In Cancerfonden's calls for proposals in autumn 2022 – its largest call to date – 149 researchers at KI were awarded a total of SEK 348 million.

The largest individual grants of SEK 10 million and SEK 8 million went to two projects within radiotherapy, an area in which Cancerfonden is investing extra. One of the projects is run at the Department of Oncology-Pathology, which received a total of approximately SEK 75 million in project funding distributed among 22 researchers. The second project is conducted by the Department of Clinical Research and Education.

Other departments that received funding include the Department of Epidemiology and Biostatistics, which received SEK 7.5 million, and the Department of Biological Sciences and Nutrition (Bio Nut), where four researchers shared SEK 10.55 million.

In Cancerfonden's spring 2022 call for proposals, a total of SEK 57.6 million was granted to 15 different projects at KI. Two projects within the field of radiotherapy also received funding in this call.

In Barncancerfonden's 2022 call for proposals, KI researchers were awarded grants of SEK 128 million, an increase of approximately 20 percent compared to 2020 (SEK 110 million) and 2021 (SEK 106 million).

Figure 24: Distribution of main research grants.

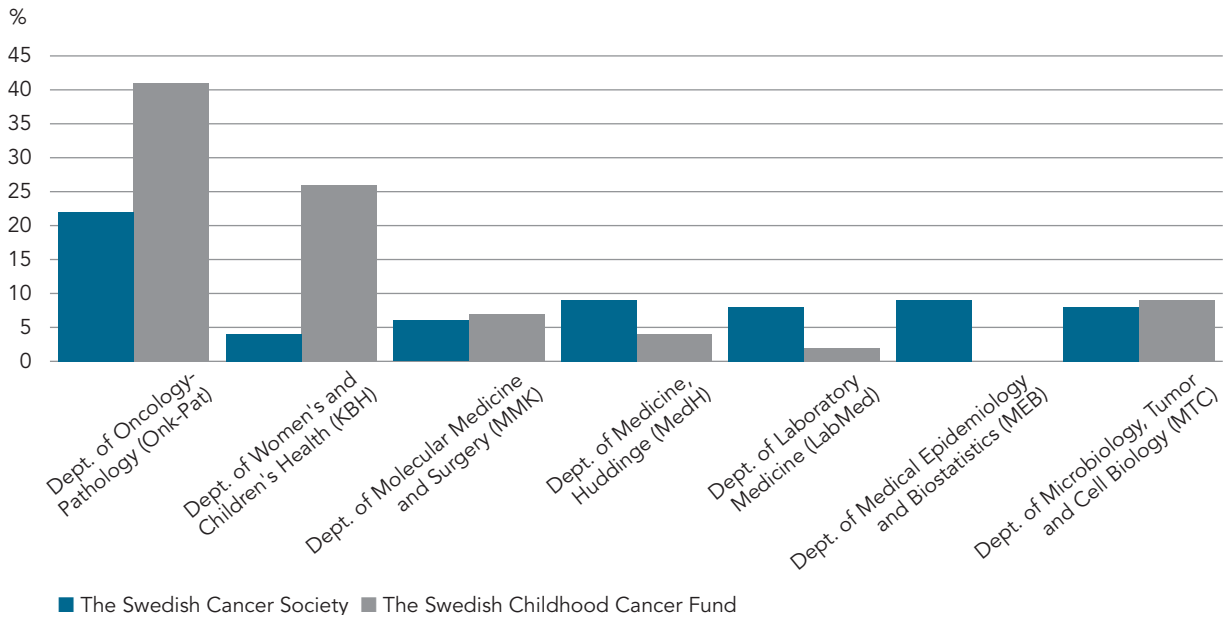


Figure 25: Theme Cancer and Cancer Research KI co-publication organisations 2020–2022. 100 organisations have been included (organisations with at least 60 publications). Edges are shown between organisations with at least 17 co-publications.

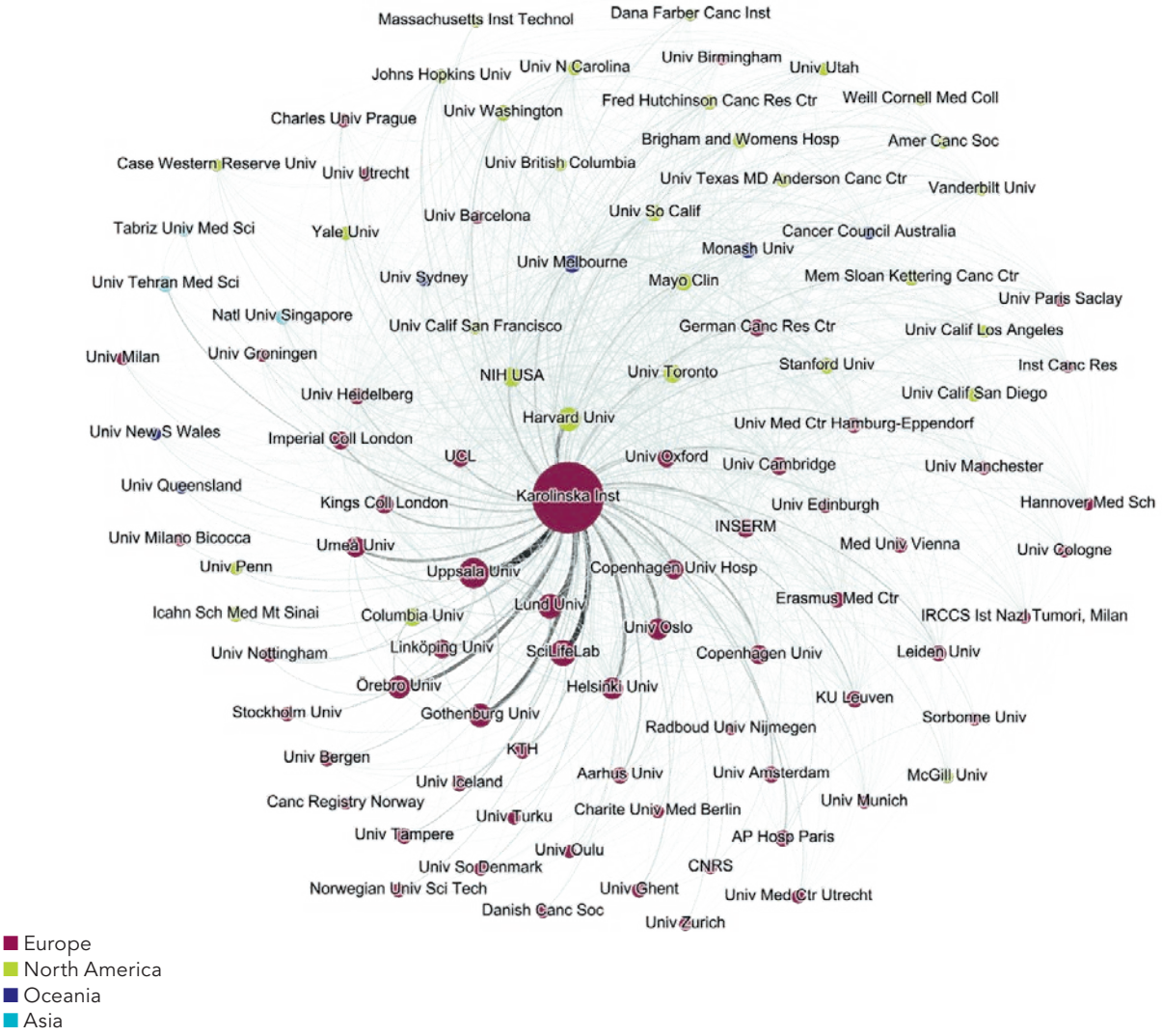
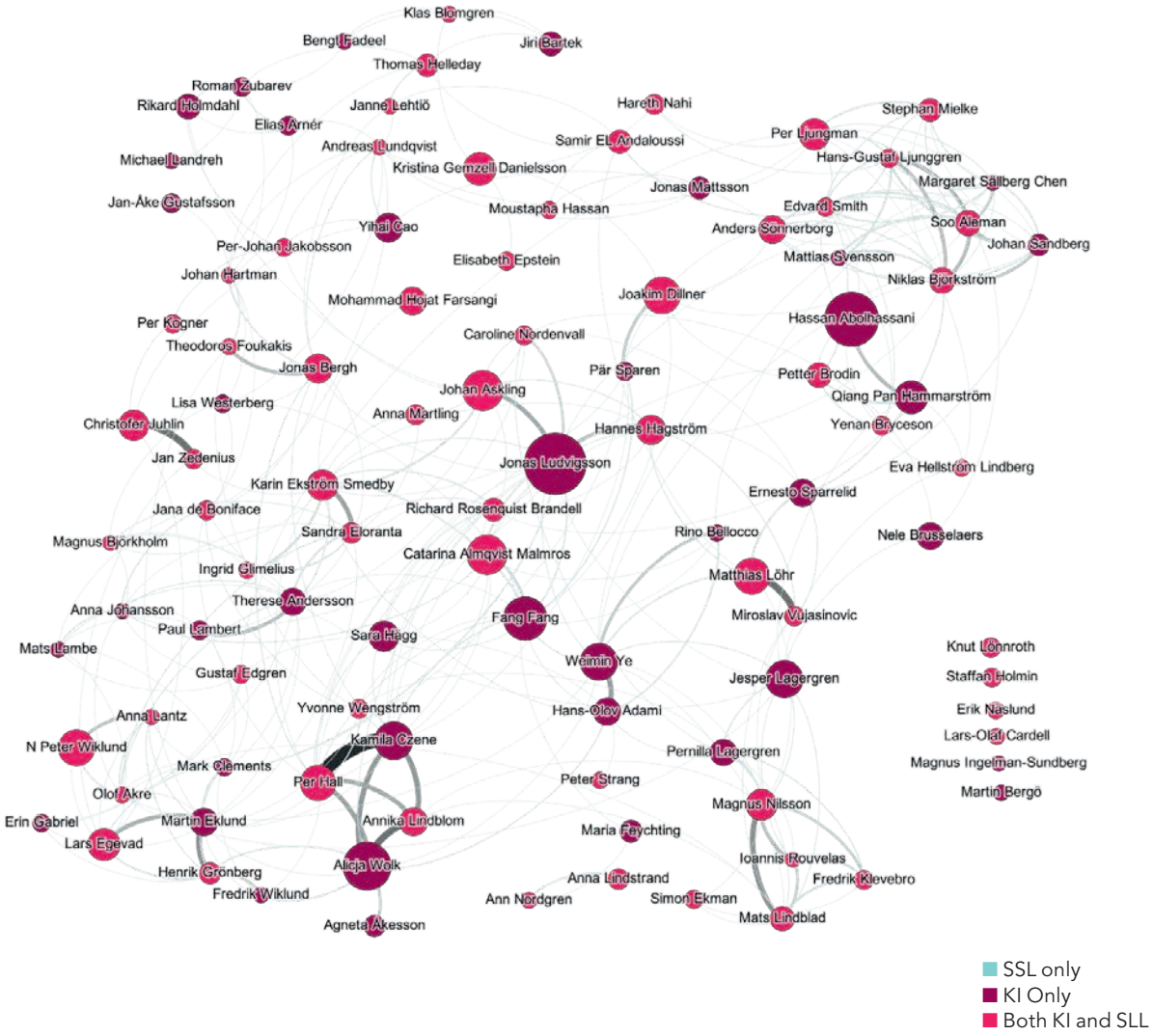


Figure 26: Theme Cancer and Cancer research KI Author network, at least 22 publications 2020–2022. 102 authors have been included. Connections between authors need at least 1 publication to be shown.



Selected publications Medical Units Theme Cancer

Upper Abdomen

Villard, C., Friis-Liby, I., Rorsman, F., Said, K., Warnqvist, A., Cornillet, M., Kechagias, S., Nyhlin, N., Werner, M., Janczewska, I., Hagström, T., Nilsson, E., & Bergquist, A. (2022). Prospective surveillance for cholangiocarcinoma in unselected individuals with primary sclerosing cholangitis. *Journal of hepatology*, S0168-8278(22)03303-7.

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Banijamali, M., Höjer, P., Nagy, A., Hååg, P., Gomero, E. P., Stiller, C., Kaminskyy, V. O., Ekman, S., Lewensohn, R., Karlström, A. E., Viktorsson, K., & Ahmadian, A. (2022). Characterizing single extracellular vesicles by droplet barcode sequencing for protein analysis. *Journal of extracellular vesicles, 11(11)*, e12277.

Tong, L., Jiménez-Cortegana, C., Tay, A. H. M., Wickström, S., Galluzzi, L., & Lundqvist, A. (2022). NK cells and solid tumors: therapeutic potential and persisting obstacles. *Molecular cancer, 21(1)*, 206.

Celltherapy and Allogen stemcell transplantation

Gao, Y., Cai, C., Wullimann, D., Niessl, J., Rivera-Ballesteros, O., Chen, P., Lange, J., Cuapio, A., Blennow, O., Hansson, L., Mielke, S., Nowak, P., Vesterbacka, J., Akber, M., Perez-Potti, A., Sekine, T., Müller, T. R., Boulouis, C., Kammann, T., Parrot, T., … Buggert, M. (2022). Immunodeficiency syndromes differentially impact the functional profile of SARS-CoV-2-specific T cells elicited by mRNA vaccination. *Immunity, 55(9)*, 1732–1746.e5.

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Boman, C., Edman Kessler, L., Bergh, J., Matikas, A., & Foukakis, T. (2022). Women with short survival after diagnosis of metastatic breast cancer: a population-based registry study. Breast cancer research and treatment, 194(1), 49–56.

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Pedone, C., Sorcini, B., Staff, C., Färlin, J., Fokstuen, T., Frödin, J. E., Nilsson, P. J., Martling, A., & Valdman, A. (2022). Preoperative short-course radiation therapy with PROtons compared to photons in high-risk RECTal cancer (PRORECT): Initial dosimetric experience. Clinical and translational radiation oncology, 39, 100562.

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Appelgren, M., Sackey, H., Wengström, Y., Johansson, K., Ahlgren, J., Andersson, Y., Bergkvist, L., Frisell, J., Lundstedt, D., Rydén, L., Sund, M., Alkner, S., Vrou Offersen, B., Filtenborg Tvedskov, T., Christiansen, P., de Boniface, J., & SENOMAC Trialists' Group (2022). Patient-reported outcomes one year after positive sentinel lymph node biopsy with or without axillary lymph node dissection in the randomized SENOMAC trial. *Breast (Edinburgh, Scotland), 63,* 16–23.

Development and innovation

Precision Medicine Centre Karolinska

Precision medicine allows for tailored prevention, diagnosis, treatment and follow-up based on the individual patient's unique circumstances, such as genetic profile and specific biomarkers. In other words, providing the right interventions to each individual patient at the right time. Treatments become both more efficient and more financially viable. It also reduces unnecessary suffering for patients.

The mission of the Precision Medicine Centre Karolinska, PMCK, is to create organisational conditions for the development and orderly introduction of precision medicine in healthcare. This is a unique opportunity to translate cutting-edge research and rapid technology development into concrete patient benefits, by creating the framework and conditions for implementing research into care and translating theory into practice.

PMCK is the arena for collaboration between the hospital and the KI - an innovation environment where conditions are created for the concrete implementation of precision medicine in highly specialised healthcare.

Precision Medicine Forum Cancer (PM Forum Cancer)

Kristina Sonnevi manages the work within PM Forum Cancer where representatives from Theme Cancer, Theme Children, MDK, SciLifeLab, the cancer study unit and others are included. During the year, work has focused on continuing to identify the bottlenecks to further expanding precision medicine analyses within cancer, where we are currently working primarily with genomics. Preparatory work to enable developments within proteomics, AI in radiology, etc. is also underway. Secondary objectives during the year have been:

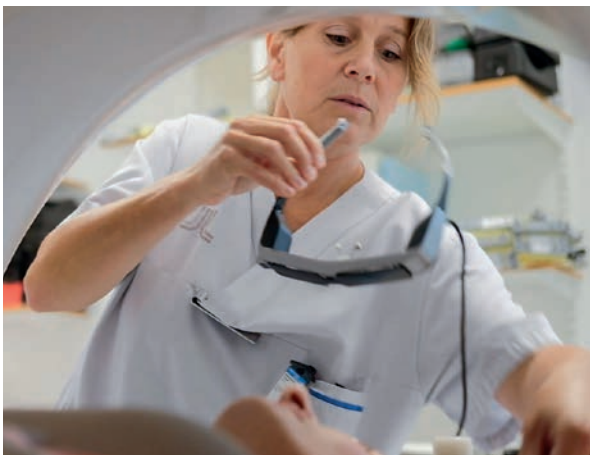
- Structured review of future needs in all different parts of Theme Cancer and Theme Children through more explicit involvement of representatives from the business
- Detailed mapping of flows including sample management and data management
- Development of follow-up models and cost models
- Updating forecasts and plans for new analyses and flows
- Collaboration on opportunities to attract and formulate employment forms for new professions in e.g., bioinformatics required for scaling up precision medicine

Resident training in precision medicine for resident physicians within oncology, haematology, laboratory medicine, clinical genetics, pathology, and paediatrics.

Data-driven and individualised care

During 2022, Karolinska CCC in collaboration with RCC Stockholm Gotland has developed and implemented automated transfer of information around standardised care processes. The key is based on marking the date of a decision on a substantiated suspicion in the medical records, where it is most natural, which can then be extracted automatically and transferred to quality registers and used secondarily for internal follow-up. This frees up administrative resources, creates good coverage in national registers and creates the conditions for being able to visually follow the patient's path through care in real time in the future.

In the SYMPHONY project, which involves Karolinska, Cambio, Cuviva, KI and Philips and is funded by Vinnova, we will work together to automate workflows and data collection with the aim of "record data once, use it often." SYMPHONY builds on the work of the innovation partnership between Karolinska and Philips around prostate cancer with a particular focus on annotated radiology images and patient-reported measures.



MinKod

The innovation project minKod, about and with teenagers and young adults (16–30 years) in cancer care with the overall goal of improving the lives of teenagers/young adults with cancer, has developed and implemented several new solutions and work methods during the year. Patient involvement is one of the keys to the success of the project, with several young people with cancer experience both participating and managing the working group.

Among other things, the focus in 2022 has been to test a new treatment method called Promoting Resilience in Stress Management (PRISM) in a pilot study. It is an individual psychosocial programme for young people who have recently been diagnosed with cancer and is carried out together with a social service officer or a psychotherapist within the CCC. The evaluation shows that those who completed the programme took away tools for coping with the stress of everyday life with cancer.

Design sprints with people with cancer experience, the Centre for Person-Centred Care and one of the corporate partners, CareChain, have resulted in a prototype Peer to Peer solution called Pejla. It was developed to enable young people to provide emotional support to each other and has been tested by the target group during the year.

A prototype of "chatboten Charlie – din guide i myndighetsdjungeln" (Charlie the chatbot – your guide in the government jungle) has been developed together with one of the corporate partners, KPMG. The chatbot has been tested by several people with cancer experience from UngCancer (Young Cancer) and health professionals and has been further improved during the year. It has been created to help young adults with cancer navigate through information from Swedish Social Insurance Agency (Försäkringskassan), Swedish Public Employment Service (Arbetsförmedlingen) and Swedish Board of Student Finance (Centrala studiestödsnämnden, CSN).

Information texts about the disease and treatment in My Care Plan via 1177 have been adapted for the group of young patients in collaboration with people with cancer experience. This has been completed and implemented nationally via the Regional Cancer Centre for all diagnoses using the tool.

Nursing strategy for Theme Cancer

In the spring, 57 Nursing Directors met to strengthen leadership and create a network of managers, in part to work on a common strategy for developing care together. To help this along, two researchers within implementation were invited to moderate the day. When all Nursing Managers and Nursing Directors meet, we observe that the cooperation and community around the work ahead is strengthened. Networking strengthens leadership and is essential to the success of nursing challenges.

During the autumn, our Care Unit Managers and Nursing Managers have completed the strategy work and there is now a defined strategy with five areas and working groups for each area. The working groups reported to the Nursing Forum.

Figure 27: Strategic nursing areas

We provide high-quality care, research, and education to an international standard.

We continuously improve patient care through systematic nursing development.

We are an attractive workplace with a strong multi-professional collaborative culture.

To the left: Frans Karlsson, Production Controller, Karolinska CCC. Analyses and produces data from healthcare IT systems.
To the right: Louise Svanström, Quality Coordinator, Karolinska CCC. Former Head Nurse.

The business development team at Karolinska CCC meets the challenges of the future

The business development team at Karolinska CCC strengthens the operations to become world leaders in research, development and care. Four dedicated business developers describe the past year of high goals, how they work, what is key to success and what Karolinska CCC means to them, to patients and to employees. Join us when we meet Louise Svanström, Marie Bothén, Frans Karlsson and Frida Bulukin Wilén.

What does Karolinska CCC mean to you?

"Karolinska CCC is a seal of quality; the accreditation has united us who have a focus on cancer. We have the same goals, we know our strengths and weaknesses. Now it is about improving and taking the next step," says Louise Svanström, Quality Coordinator, Karolinska CCC.

"As a Comprehensive Cancer Centre, we work together, we collaborate in a new way with a common strategy and goals. This gives us the conditions to support the organisation to drive the changes we have jointly decided," says Marie Bothén, Head of Operations, Karolinska CCC.

"We want to keep our accreditation, it gives direction and creates a momentum going forward."

"We are incredibly motivated by what the patient representatives describe about participation and their experiences of being able to influence their care," says Frida Bulukin Wilén, Business Developer Karolinska CCC.

The business development team is characterised by broad expertise, a focus on solutions and being helpful. The team strengthens the holistic perspective where clinical activities and research should benefit each other. Not just regionally, but nationally and internationally.

What happens through a business development team that would not otherwise be possible?

"We can participate constructively in hospital-wide projects and represent the needs of the Karolinska CCC. For example, we now have daily data transfer from a cytostatic management software to the common data warehouse at Karolinska. A system where we prescribe cytostatic medicinal products for about 6000 patients annually. From the system, we have been able to develop real-time overviews, follow-up reports for managers and we can analyse the entire flow. Everything from medicine prescription to medicine billing or surgery, to adjuvant treatment," says Frans Karlsson, Production Controller, Karolinska CCC.

To the left: Frida Bulukin Wilén, Business Developer Karolinska CCC. Focuses on digitisation and strategic development issues. To the right: Marie Bothén, Head of Operations, Karolinska CCC. Responsible for the team, part of the management team for Theme Cancer.

"My best example is the work on a process view for medical treatment. It shows an overview of all planned patients and whether they are prepared for treatment in the right way with prescribing, testing, symptom control etc. It reduces a lot of administrative time and makes the nurse's job more enjoyable," says Frida Bulukin Wilén.

What is the plan for business development in the coming years?

"Our big mission is a data-driven approach that will benefit both clinicians and researchers. We always think that digital initiatives should optimally benefit the patient and the community's digital involvement. It takes a lot of effort to get there," says Frans Karlsson.

"Finding new ways of working is crucial, as the patient base is growing but the number of staff is not. We need to reduce administrative tasks with digital solutions. Less administration means more job satisfaction for employees and good data support increases the possibility of fact-based decisions. Clear visualisation makes it easier for employees to understand their part in the process and to identify needs more quickly for improvement," says Louise Svanström.

"The dream scenario of the future is to become a world leader and a model within the field of cancer, from research to clinical practice. The goal is to work together with the other Comprehensive Cancer Centres to drive development forward," concludes Frida Bulukin Wilén.

Examples of projects completed in 2022

Automation of SVF data to INCA

Instead of duplicating information in medical record systems and then in the SVF registry on the INCA platform, we now have real-time automatic transmission. This is good both for the registry nationally and for being able to follow our patients' path through care in real time. The same measurement points create the condition for us internally to visualise our lead times without any manual intervention.

Cytodos & ELAS, ARIA

Integrations of IT systems for cytostatic and radiotherapy management to the Karolinska data warehouse enable daily transfer of output from the systems and allow us to use the information for analysis, planning and follow-up.

Improved production planning process with all managers involved

Production planning is a comprehensive process in which we prepare a weekly plan for all outpatient, inpatient, surgical and diagnostic services for our patients prior to each year. It is implemented by all managers within Theme Cancer and together with related themes and functions. In 2022, we have focused on making all managers feel involved throughout the process, but also on simplifying follow-up against the plan through subscriptions to weekly reports.

Barbro Sjölander, Patient Representative

Anita Wanngren, Patient Representative

Patient representatives' views on patient involvement 2.0

Involvement of patients/close relations is essential for better research and healthcare. We observe that Theme Cancer has taken note of this and developed Patient Involvement 2.0 and initiated the implementation. In our role as patient representatives, we have seen the difference patient involvement makes. We can use the experiences of those affected and close relations to make a difference, and that encourages us to continue.

For the strategic collaboration we have with managers within Theme Cancer, we have had five meetings during the year. Two patient representatives, Anita Wanngren and Barbro Sjölander, have been appointed by the Patient and Close Relation Council at the Regional Cancer Centre (RCC) Stockholm-Gotland to represent them at these meetings. As patient representatives, we were able to choose topics to address. The management of Theme Cancer has informed us about ongoing projects and prepared presentations for the topics we wanted to discuss.

Patient representative Karin Liljelund has also participated in several projects.

Examples of projects involving patient representatives:

- Increased availability evenings and weekends
- Published outcome data
- Accessibility project
- Physician continuity

Planning ahead

Decisions have been taken on how to organise patient involvement for the activities and to set up a Patient Council (network) to have resources available for participation in new projects or clinical studies in all phases, planning, implementation and presentation.

In 2023, the strategic group will continue to focus on

- Patient involvement
- Precision medicine
- Rehabilitation
- Palliative care

We have also initiated that we will be involved in developing how to apply the patient criteria in the re-accreditation of Karolinska CCC.

In summary, we could say that we are moving towards "Patient Involvement 3.0."

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Karolinska Comprehensive Cancer Center