Annual report 2019

The Intervention Centre

Division of Emergencies and Critical Care, Oslo University Hospital

ANNUAL REPORT 2018

The Intervention Centre

ANNUAL REPORT 2019
More information: www.ivs.no

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Offering multimodal image guidance during surgery

In 2019 the Intervention Centre opened some of the most advanced ORs in the world, thereby expanding our capacity. Two hybrid rooms combining angiography in advanced ORs were used by cardiologists, vascular surgeons, ENT specialists and Neuro surgeons.
In Collaboration with the cardiology department more than 300 TAVIs were performed in the angiographic hybrid rooms. Advanced aortic stent with fenestrated grafting sometimes comprising the aortic arch has become a routine was procedure.

Together with Siemens we built two suites, one hybrid suite and one standard OR suite. Through a sliding door the Siemens Prisma CT can move on rails thereby serving both rooms. Intraoperative CT allowed expansion of CT guided liver ablation as treatment of liver metastases and CT guided implantation of electrodes for deep brain stimulation.

In the endoscopy suites patients with liver metastases and pancreatic tumors were offered laparoscopic resections. Our scientists published extensively on the advances of minimally invasive treatment, and thanks to the Intervention Centre, our hospital today have a comprehensive experience in laparoscopic liver and pancreas surgery.

Through this expansion, the Intervention Centre run 9 suites both for advanced minimally invasive and image guided treatment to patients and for pre-clinical trial on animals for the med tech industry. All clinics in the hospital had projects either involving patient treatment, or research

Through our collaboration with Norway Health tech – a cluster established by the med tech industry together with the main universities and university hospitals in Norway, the Intervention Centre provide test bed facilities and support for pre- clinical and clinical trials. Through the Nordic initiative Nordic Poof – connecting university hospitals in Finland, Iceland, Denmark, Sweden and Norway, the Scandinavian university hospitals can offer a robust test environment to the health care industry world wide.

In 2019 the Intervention Centre also expanded two other services for the clinical departments in our hospital.

We now provide access to a NVIDIA server for development of advanced AI algorithms to the whole hospital and university of Oslo. AI will be an integral part in image interpretation and decision support in health care.

The Intervention Centre is the host of the BIGMED project addressing the bottlenecks for precisi0on medicine. This project, involving several clinics in our hospital, the Universities of Oslo and Trondheim and several companies, has paved the way for introducing precision medicine in clinical practice in Norway. The AI infrastructure is an integral part of this, we also believe the collaboration with Sykehuspartner – the main provider of IT services for the South-East region will provide an infrastructure for precision medicine and modern research involving big data.

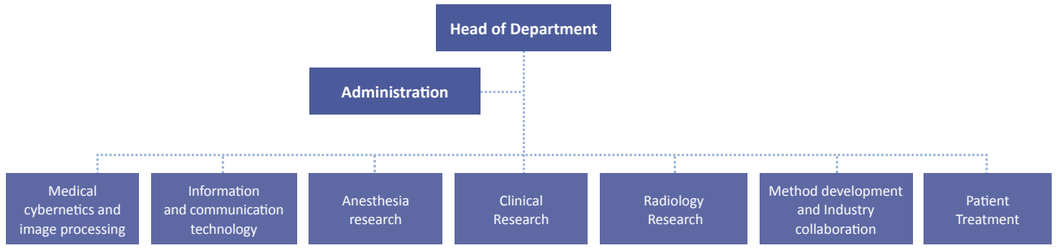
The other service could be termed three dimensional presentation of images along two arms. We either can offer 3D printing based on MR and CT images for surgical planning, or provide holographic presentation. Together with the company Soprasteria we established the company HoloCare based on their Hololens technology. The company will provide systems for surgical planning and for education.

We have definitely entered the era of digitalized medicine, where images and other the patient information can be used for better, more accurate and less invasive treatment for the patients.

Erik Fosse

The intervention Centre is organized as a department in the Clinic for Emergencies and Critical Care.
The Centre provides a shared resource for basic- and clinical research groups inside and outside Oslo University Hospital. All research groups have the same access to the advanced equipment, infrastructure and necessary competent staff needed for research and development of new methods. The Centre is organized in a matrix model with six sections.

2.1 Organization map



2.2 Deliveries

The Centre's R&D tasks are:

- Development of new treatment methods
- Development of new treatment strategies
- Comparison of established and new treatment methods
- Studies of social, economic, and organizational consequences from implementation of new methods

To perform this type of studies the Centre has established an infrastructure that facilitate four result dimensions:

1. Clinical Trials (with clinical outcome endpoints)
2. Patient experience studies (including QOL and qualitative methodology)
3. Health Economy studies (cost/efficacy for patients, hospital and society)
4. Organizational consequences from new methods

Main focuses for research are:

- MRI-guided interventions and surgery
- Radiology guided interventions and surgery
- Use of robot systems and simulation

- IT solutions for big data processing and artificial intelligence
- Telecommunication and sensor technology
- Radiology and image processing
- Navigation systems for interventions and surgeries
- CT-guided interventions and surgeries

In addition to scientific project industry sponsored studies for testing of new medical devices are performed.

2 ORGANIZATION

2.3 Infrastructure and resources

The Centre's infrastructure and resources includes:

1) Access to high end equipment in operating rooms dedicated for technological-, preclinical- and clinical research for internal and external projects.
   - Two multi modal/hybrid angio/videofluoroscopy operating rooms
   - Two videoscopy operating rooms with mobile C-bow and surgical robot
   - One operating room surgical microscope and navigation equipment adjacent to MRI
   - Two multi modal/hybrid operating rooms with possibilities for intra operative CT
   - One preclinical operating room

The multi modal operating rooms are unique and not available elsewhere in the hospital. Thus, the Intervention Centre offers capacity for treatments where this unique combination of modalities is required.

2) Specially trained staff (medical specialists, nurses, radiographers, engineers, project leader) to handle the complex infrastructure in technological and research-based settings.
3) IT infrastructure for data extraction of data from all operating rooms.

2.4 Human resources

The department head, Erik Fosse MD Professor reports to the head of the Clinic for Emergency Medicine.
The administrative staff supports the head of department in the overall management of the department, and consists of:

Marianne Berg, Administrative Advisor
Agnes Gregersen Eriksen, Administrative Consultant
Steinar Munkvold (to be replaced by Mai Eide Frey in 2020) Special advisor Economy and Quality
Linda Engvik Operation room coordinator
Kjersti Wendt, Research coordinator

2.5.1 Section for Clinical Research

Head of Section Bjørn Edwin, Professor, MD

Staff

Åsmund Avdem Fretland, consultant surgeon
Kine Anita Lindstrøm, OR nurse
Anuska Radeska Skau, OR nurse
Olga Skagseth, OR nurse
Anne Marie Marstein, OR nurse
Victoria Juhasz, Laboratory assistant
Sharon Tamson Andersen, Laboratory assistant
Davit Aghayan, PhD candidate
Egedijus Pelanis, PhD candidate

Deliverables

- Research and development in minimally invasive surgery in the premises of The Intervention Centre
- Development and education in new techniques at Oslo University Hospital and other hospitals in Norway
- Clinical R&D in all medical domains
- Perform minimally invasive treatment of patient groups where the volume of patients within these disease groups is too low to develop secure new treatment strategies on many sites
- Perform minimally invasive treatment of patient groups requiring established multiprofessional collaboration and infrastructure currently uniquely found at The Intervention Centre. Examples are; laparoscopic pancreas and liver surgery, laparoscopic endocrine surgery, laparoscopic endometriosis surgery, laparoscopic back surgery

Main Objectives

- The section's activities are focused on minimally invasive treatment in all surgical specialties
- The section shall be leading both nationally and internationally within its focus area within research and development
- The section shall assist and initiate research minimally invasive therapy projects
- The section promotes education locally, regionally, nationally and internationally
- The section stimulates multiprofessional collaboration because:
  - Minimally invasive therapy is performed in many professional settings by various specialists and thereby a common field of interest across specialties
  - Minimally invasive therapy depends on development within technology and radiology

2.5.2 Section for Radiology Research

Head of Section Ragnhild Marie Undseth, MD, PhD;Radiologist

Staff

Hilde Sofie Korslund, radiographer
Grethe Løvland, radiographer
Kenneth O. Pedersen, radiographer
Jorunn Fraser-Green, radiographer
Margrethe Kallestad Rasmussen, radiographer
Alexis G.Hinojosa C, radiographer.
Svein-Are Vatnehol, radiographer
Till Schellhorn, radiologist
Ragnhild Undseth, radiologist, section manager

Deliverables

- Radiological support and service to all experimental and clinical projects at The Intervention Centre
- Radiological examinations of animals and patients treated at The Intervention Centre
- Training and supervision of healthcare personnel in new image-guided treatment techniques
- Research group in the field of MR guided High Intensity Focused Ultrasound Treatment

Main Objectives

- Have a highly qualified staff
- To be nationally and internationally leading environment for image guided treatment
- Strengthen interdisciplinary research and increase number of regional, nationally and internationally joint projects.

2.5 SECTIONS

2.5.3 Section for Anesthesiology Research

Head of Section Per Steinar Halvorsen, Professor, MD, PhD

Staff

Andreas Espinoza, anesthesiologist
Kjersti Wendt, nurse anaesthetist
Anton Amalathasan Josephmary, nurse anaesthetist
Torill Schou, nurse anaesthetist
Guttorm Larsen, nurse anaesthetist
Irene Fellie Bjaaland, nurse anaesthetist
Helen Littorin-Sandbu , nurse anaesthetist
Marit Pettersen, nurse anaesthetist

Deliverables

- Anesthesia service to all clinical and experimental projects at the Intervention Centre
- Training/supervision of healthcare personnel in anesthesia
- Innovation/DOFI/patents
- Research group in the field of cardiovascular monitoring

Main Objectives

- Contribute to improved quality of experimental and clinical research
- Have a high qualified staff
- Interdisciplinary research and increase the number of joint projects
- Contribute to increased innovation and secure intellectual property

2.5.4 Section for Medical Cybernetics and Image Processing

Head of Section Ole Jakob Elle, Professor UiO, PhD

Staff

Espen Remme, Senior Researcher in 30%, PhD
Rafael Palomar MSc., Researcher Software, PhD (OUS, Lecturer NTNU)
Rahul Kumar, Postdoc/Researcher Image processing, PhD
Magnus Leon Reinsfelt Krogh, PhD fellow
Henrik Brun, Postdoc 50%, Pediatric Cardiologist, Planning of surgery on congenital heart diseases using Mixed Reality Visualization and 3D printing
Robin Bugge, Image processing in 20%, MSc.
Carl Joachim, Mathematician, 3D model Segmentation and 3D printing, MSc.

Pravda Jith Ray, PhD Fellow, Deep Learning segmentation (HiPerNav)
Andrea Teatini, PhD Fellow, Navigation and visualization (HiPerNav)
Ali Wajdan, PhD Fellow, signal processing accelerometer data (PIC)
Manuel Villegas, PhD Fellow, heart monitoring using accelerometer data (PIC)
Yuliia Kamkova, PhD Fellow, Deep Learning segmentation (Internal Akuttklinikken

Deliverables

- Development of technological solutions, prototypes and demonstrators to solve medical challenges
- Research and publication
- Innovation within medical technology and their applications
- Intelectual property
- Multidisciplinary expertise within technology including image processing, visualization and navigation, robotics, sensors and signal processing as well as machine learning based solutions
- Supervision of students and PhD-fellows
- Teaching
- Support clinical activity at The Intervention Centre that need the sections technological solutions or expertise

Deliverables

The Section for Section for Medical Cybernetics and Image Processing at The Intervention Centre aims to develop cutting-edge technological solutions supporting the whole chain in patient diagnostic and treatment. Such as user interaction and information exchange in the operating suites, procedure planning, patient monitoring, and technology for minimally invasive therapies including intra-operative model update. This R&D covers a span of different technologies like monitoring technology, image and video processing, visualization, navigation technologies, biomechanical organ modelling and robotics. The solutions should give more information to the surgeon, such as sensor information and image information, during intervention and presenting this information by real-time visualization.

With the ability to adapt and compensate to the deformations and motions, this information can be used to effectively guide the clinician throughout the procedure or update a robotic path to perform the desired action. This means that when you develop algorithms for diagnostics and preoperative use, less effort is put into making the algorithm fast and effective. Intra-operative use means that the algorithms used should be able to run in real-time or close to real-time. Image and video processing methods are key elements in any software system which supports minimally invasive procedures. In particular, we are focused on developing real-time image-segmentation and -registration methods where segmentation methods finds important anatomical structures such as tumors and vessel structures in images, while registration methods enables fusion of images and images to patient.

Visualization and navigation is required to present the medical images to the surgeon intraoperatively. Increased accuracy and safety may result by cross-linking medical image information with robotic systems in so-called semi-autonomous robotic systems. Biomedical models and simulation technology are developed, intended for clinical decision support such as if, when and type of surgery should be performed. Both peri-operative patient monitoring and processing of data from different sensors as well as processing of image data in two, three and four dimensions, Machine learning (ML) and especially Deep Learning (DL) as part of Artificial Intelligence (AI) domain have become a focus area in order to automate processes and make decision support systems. In this sense also fast processing using High Performance Computing (HPC) is of outmost importance.

In order to be able to lead large research projects in the forefront internationally, the section should at all time have the needed competence and in-depth knowledge within medical informatics, such as software engineering, computer graphics and visualization, signal processing, image and video processing, robotics, cybernetics and mechanics. The head of section as well as the research group leaders should have high scientific qualifications, if possible at a professor or associate professor level and work in the intersection between technology and medicine. The section should work closely with different clinicians within the hospital as well as collaborating with well-known research institutions and industry both nationally and internationally. It is a goal that senior researchers have adjunct positions at UIO or NTNU.

Main Objectives

It to be a nationally and internationally leading research environment in technological solutions for in the following research areas:

Main research areas:

- Developing new building block for navigation technology in different surgical disciplines like laparoscopic liver resection, neurosurgery and catheter-based interventions. Such building blocks rely on new preoperative and intra-operative image analysis/processing algorithms, where the intra-operative methods need to consider real-time or near to real-time constraints such as segmentation, volume visualization and co-registration.
- Robotic technology ranging from haptic feedback and augmented reality in tele-surgical systems, semi-autonomous systems for support in the operating theatre and miniaturized robotic systems on the tipof a catheter or in a pill-cam system.
- Explore more research in areas like targeted treatment, new imaging techniques and micro technology.
- Biomedical modelling of organs like heart, liver etc., using advanced mathematical models like finite element (FEM) describing tissue properties, flow pattern for prediction and simulation.
- Development of new monitoring technology e.g. accelerometer and gyro sensors including advanced signal processing for detection of changes in heart conditions.
- Support AI infrastructure at The Intervention Centre, and be in the forefront using AI and develop/apply.
  Machine Learning algorithms for automation and decision support within patient monitoring and image processing/navigation.

The section for Medical Technology Research aims for supporting the clinicians in the OR with new technological methods and new technology

2.5.5 Section for Information and Communication Technology

Head of Section Ilangko Balasingham, Professor

Staff

Sr. Researcher Jacob Bergsland, MD, PhD
Associate Professor Ali Khaleghi, PhD
Associate Professor Laura Slaughter, PhD

Project Leader
Knut Korsell

Deliverables

- Research and publication
- Innovation in medical signal processing and communications technology
- Development of technological solutions, prototypes and demonstrators
- Intellectual property and management methods
- Multidisciplinary expertise in medical signal processing including machine learning and sensor communication technology
- Supervising students and fellows
- Teaching

Main Objectives

- to be at the forefront nationally and internationally in research and development of medical signal processing and communications technologies, and to advise on operational and acquisition projects at the Centre
- to lead advanced research projects that are in the forefront of international research to develop technological solutions for patient monitoring and new treatments, including minimally invasive and image-guided therapy
- to encourage their staff to have academic adjunct positions outside hospital and have sufficient staffing and expertise to assist various projects initiated by other communities and contribute to a seamless collaboration between technologists and clinicians
- to provide any necessary technical manpower and expertise to participate in the multidiscipli nary projects at the Intervention Centre and support patient diagnosis and treatment with the following target areas during the period:
  - ✓ develop new medical sensors based on bio-nano technologies (biological nano electronics)
  - ✓ develop communications and computing systems based on biological organisms, such as molecules, cells and organs that can communicate with the Internet and cloud services for storing and processing large amounts of data
  - ✓ develop new algorithms and machine learning methods for processing and understanding of complex, large amounts of data from sensors, germplasm, medical records, test results, images, etc. in conjunction with high precision diagnosis, treatment and follow-up
  - ✓ perform research and development of basic research in the form of new theories, mathematical modeling, computer-aided simulations and prototype development to preclinical testing and validation - “from bench to bedside”

2.5.6 Section for Method Development and Industry Collaboration

Head of Section Karl Øyri, PhD

Staff

Karl Arne Johannessen, MD, PhD, Senior Consultant
Hans Comtet, PhD Fellow

Deliverables

- Coordination of the commercial Test-Bed function at The Intervention Centre
- Collaboration with Inven2 and negotiate with companies who intends to explore new technologies and collaborate with industrial partners about development protocols
- Involves relevant clinical groups at Oslo University Hospital in projects
- Make sure that all test projects are made in compliance with guidelines at Oslo University Hospital and the health authorities regarding animal and human research
- Project management support and health economy evaluation support to clinical groups who establish new technology dependent treatment methods
- Edit the Annual Report at The Intervention Centre
- Responsible for the communication strategy at The Intervention Centre
- Responsible for the Quality System at The Intervention Centre

Main Objectives

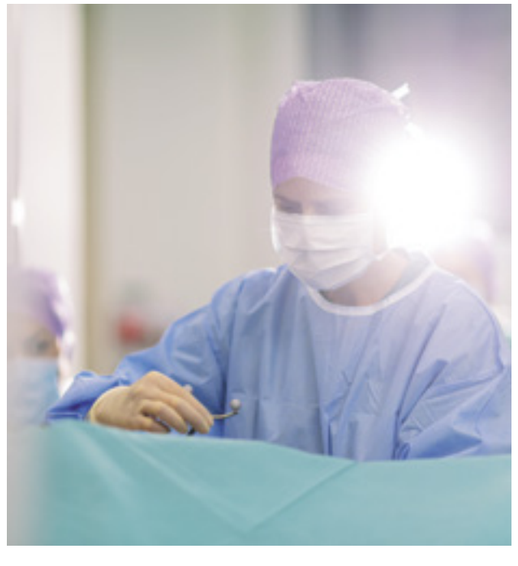
- Is a gateway to the hospital for companies who need testing of new technologies. At least five new collaboration agreements are made with industrial companies annually
- Assists project leaders with organization, contracts and required documentation
- The Annual Report is published in the spring semester
- Regular updates of the webpage
- Responsible for Quality System maintenance including editorial responsibility

Research Groups

Clinical Testing Work Group

2.5.7 Section for Patient Treatment

This is a technical section for administrative purposes.



3.1 Clinical and experimental cardiovascular monitoring

Group leader: Per Steinar Halvorsen, Professor, MD, PhD

Group members

Andreas Espinoza, MD, PhD
Helge Skulstad, MD, PhD
Jo Eidet, MD, PhD
Ole-Johannes Grymyr, MD, PhD
Harald Bergan, MD, PhD
Itai Schalit, MD, PhD Fellow
Kristin Wisløff-Aase, MD, PhD Fellow
Hilde Karlsen, MD, PhD Fellow
Marte Sævik, MD-PhD Fellow
Marius Erichsen, MD, PhD Fellow
Simon Jakobsson, MD

Associated group members

Professor Leiv Arne Rosseland, MD, PhD
Professor Arnt Fiane, MD, PhD
Jan Hovdenes, MD, PhD
Jan Otto Beitnes, MD, PhD
Espen Remme, MSc, PhD
Christian Tronstad, MSc, PhD
Magnus Reinsfelt Krogh, MSc, PhD Fellow
Ivar Nagelgaard Omenås, MD, PhD Fellow
Pengfei Lu, MSc, PhD Fellow
Mohammad Albatat, MSc. PhD Fellow

3 RESEARCH GROUPS

Main aims

- Develop and test new technologies in cardiovascular monitoring
- Cardiovascular response to new cardiovascular therapies
- Myocardial function in therapeutic hypothermia and severe sepsis
- Test artificial intelligence/machine learning on continuous vital signs data

This We perform both in-vitro and in-vivo studies and current technologies under investigation for cardiac function monitoring include implantable 3D accelerometers, gyro and miniaturized ultrasound sensors.

Ongoing research projects

- Trans Aortic Valve Implantation (TAVI): is myocardial reserve related to long term outcome?
- Accelerometer for detection of thromboembolic events and loading conditions in LVAD treatment.
- Accelerometer/gyro/magnetometer for monitoring cardiac function and loading conditions.
- Multifunctional pacemaker systems for cardiac resynchronization therapy (CRT)
- Effects of therapeutic hypothermia on myocardial function during cardiac surgery
- TTM II sub study: Therapeutic hypothermia in the post resuscitation phase myocardial effects and long term outcome.
- Effects of epinephrine on systolic and diastolic left ventricular function during therapeutic hypothermia
- New decision support system for improved hemodynamic monitoring during bleeding

Collaborations

- MARIE SKŁODOWSKA-CURIE ACTIONS Innovative Training Networks Project: “PIC – Personalized In-silico Cardiology”: Espen Remme, MSc, PhD, The Intervention Centre and Department of Cardiology, Oslo University Hospital.
- MARIE SKŁODOWSKA-CURIE ACTIONS Innovative Training Networks Project: “WiBEC -Wireless In-Body Environment”. Coordinator/PI Prof. Ilangko Balasingham, The Intervention Centre, Oslo University Hospital and NTNU.
- Biosensor Research Group at Oslo University Hospital: Professor T. I. Tønnessen
- Complement Research Group at Oslo University Hospital: Professor Tom Eirik Mollnes

3.2 Image guided general surgery and intervention

Group leader: Bjørn Edwin, Professor, MD

Group members

Dr. Mushegh Sahakyan PhD,
Dr.Bård Røsok PhD,
Dr.Airazat Kazaryan PhD
Dr. Åsmund Avdem Fretland PhD, consultant surgeon
Stig Ronny Kristiansen, IT-researcher,
Prof. Kjersti Flatmark,
Karl Øyri, PhD, section leader
Dr. Leonid Barkhatov, PhD Fellow,
Prof. Dejan Ignatovic, dr. Davit Aghayan, PhD Fellow
Prof. Trond Buanes,
Dr. Sheraz Yaqub PhD
Dr. Egidius Pelanis, PhD fellow
Dr. Davit Aghayan, PhD Fellow

Associated group members

Prof. Ole Jakob Elle
Dr. Knut Jørgen Labori PhD
Dr.Anne Waage PhD,
Gudrun Maria Waaler Bjørnelv, PhD Fellow
Jens Marius Næssgaard, PhD Fellow
Andrea Teatini, PhD Fellow
Vanja Cengija, PhD Fellow
Ulrik Carling, PhD Fellow
Vegar Dagenborg, PhD Fellow
Javier Luzon, PhD Fellow
Yuliia Kamkova, PhD Fellow

Background

Minimally invasive surgery is evolving rapidly, and the need for systematic development and evaluation of these methods is necessary. Our group focuses on value based healthcare research of new minimally invasive surgical techniques and in addition the development of new procedures. Most of the research is conducted in the field of HPB-surgery.

(Diseases in liver, bile ducts and pancreas) and adrenal gland surgery.

Ongoing Projects

- The Oslo CoMet-study (Oslo randomized laparoscopic vs open liver resection for colorectal liver metastasis – study).
  Funding: HSØ
- In addition to the evaluation of surgical and oncological results, several translational studies are performed, such as bio banking of tumour tissue, studies on the inflammatory response, health economy evaluation and pain/quality of life studies.
- Multicentre studies on laparoscopic liver surgery
- Research on pancreatic cancer: Examining the

  role of Laparoscopic Distal Pancreatectomy in

  the treatment of Pancreatic Cancer: From a Consensus Study to Randomized Controlled Trials. The main aim is to assess the oncologic outcomes of Laparoscopic Distal Pancreatectomy (LDP) in patients with Pancreatic Distal Adeno- Carcinoma, determine the prognostic factors and provide justified recommendations for its use.
  Funding: Kvote programmet UiO

  Post Doc project called “Irreversible electroporation
  - a novel ablation modality in unresectable
  hepato-pancreato-biliary cancer” funded from
  AKU Clinic
- The research group also does research on MRI-guided High Intensity Focused Ultrasound (HIFU) of lesions in liver and prostate.
  Funding: Kreftforeningen
- Together with the University of Gothenburg, we do research on biomaterials in implants.
- Research on imaging of liver tumours (CT, MRI, PET-CT) is conducted with other research groups at the IVS and OUS.
- In a joint project, a method for automatic segmentation of liver anatomy including tumors is developed. The final goal is to create an interactive map for liver surgeons that will greatly ease both planning and the actual surgery.
- Research on reasons to onset of type 1 diabetes, DiVid study.
- Research on D3 resection of colon cancer
- The Group is also involved in many major projects e.g. HiPerNav, (EU projekt), NorMit, MetAction and BigMed.

Collaborations

In all the projects, the group has a large international network of collaborators e.g. Nasjonalt Kompetansetjeneste for ultralyd og bildeveiledet behandling, Trondheim
Tumorbiologi, Radiumhospitalet, OUS
PubGene, Oslo
A strong cooperation between the different research groups at The Intervention Centre:
Prof Robert Troisi, Policlinico Federico II di Napoli, Director Clinical Medicine and Surgery, Naples, Italy
Prof Mohammad Abu Hilal, Istituto Fondazione Poliambulanza, Bissolati No 57, 25124, Brescia, Italy
Prof Luca Aldrighetti Chief of Liver Unit, Department of Surgery, Scientific Institute San Raffaele,
University Vita-Salute San Raffaele, Milan, Italy.
Prof Alessandro Ferrero, Direttore f.f. S.C. Chirurgia Generaleed Oncologica Ospedale Mauriziano, Torino, Italy.
Prof Marc Besselink, Department of Surgery, Amsterdam UMC, Academic Medical Center, Meibergdreef 9, 1105 AZ Amsterdam, Netherlands.

3.3 Medical Robotics, visualization and navigation

Group Leader: Ole Jakob Elle, Professor, PhD

Group Members

Rafael Palomar, PhD Fellow/Software developer/Computer Graphics/Navigation
Rahul Kumar, Postdoc, Liver Image segmentation/Navigation
Espen Remme, Senior Researcher in 30% (shared IVS/Kirurgisk forskning), Heart Physiology
Magnus Leon Reinsfelt Krogh, PhD Fellow, Cardiac sensor and signal processing
Robin Bugge, Image processing in 20%, MSc., 3D-print/Heart segmentation
Egidijus Pelanis, PhD Fellow, HiPerNav
Justinas Miseikis, PhD Fellow (also at ROBIN-group at IFI/UIO), Collision avoidance
Congcong Wang, PhD Fellow (also at NTNU-Gjøvik), Denoising of lap. stereo video/3D surface extraction
Dharani Maddali, PhD Fellow (also at ROBIN/DSP-group at IFI/UIO, INIUS), Real-time Visualisation of 3D Ultrasound in Hololens
Mohammad Reza, PhD Fellow (also at ROBIN/DSP-group at IFI/UIO, INIUS), Ultrasound robot
Abbas Tariverdi, PhD Fellow (also at Institute of Physics), Flexible robotics, needle robot
Henrik Brun, Postdoc 50%, Pediatric Cardiologist, Planning of surgery on congenital heart diseases using Mixed Reality Visualization and 3D printing
Carl Joachim, Mathematician, 3D model Segmentation and 3D printing, MSc.
Pravda Jith Ray, PhD Fellow, Deep Learning segmentation (HiPerNav)
Andrea Teatini, PhD Fellow, Navigation and visualization (HiPerNav)
Ali Wajdan, PhD Fellow, signal processing accelerometer data (PIC)
Manuel Villegas, PhD Fellow, heart monitoring using accelerometer data (PIC)
Yuliia Kamkova, PhD Fellow, Deep Learning segmentation (Internal Akuttklinikken)

Research aims

Most minimally invasive procedures restrict the access and direct vision to the regions which require surgery. Such procedures require intra-operative image modalities such as x-ray, ultrasound or endoscopic images to be able to monitor the procedure in real-time. In many cases this information is not sufficient to perform the procedure accurately and safely. Merging information acquired pre-operatively, mainly from for instance MRI, CT or PET, with intraoperative data can increase the basis for decisions and thereby improve the safety and accuracy of the procedure. The Medical Robotics, visualization and navigation group develops cutting edge technological solutions which support minimally invasive procedures. In particular, the group is focused on developing real-time image-segmentation and -registration methods. Visualization and navigation is required to present the medical images to the surgeon intraoperatively. 3D video will be more and more cross-linked with medical image information and move toward robotics and automation of surgical procedures. The research group is doing research in all these fields of technology facilitating minimally invasive surgery. This includes the development of new monitoring technology e.g. accelerometer and gyro sensors with advanced signal processing for detection of changes in heart conditions as well as being in the forefront using AI and develop/apply. Machine Learning algorithms for automation and decision support within patient
monitoring and image processing/navigation.

Ongoing Projects:

The Ongoing NFR:
•NorMIT, National Research Infrastructur for Minimally Invasive Treatment

Ongoing Helse Sør-Øst:
- Hepa-Navi, Liver Navigation platform (Postdoc)
- Fast vessel segmentation algorithm (Innovation)
- Service at OUS – 3D printing of organ models (Innovation)
- Modulbasert Operasjonslys for Hybride Operasjonsstuer (Innovation)
- Måling av hjertefunksjon ved hjelp av en ny miniatyrisert bevegelsessensor (Innovation)
- HoloViz and HoloNav: 3D Mixed reality Visualization of medical images in planning and treatment (Innovation)

Other ongoing projects:
- HoloCare Cloud (BIA/NFR)

EU-project funded:
- As participant of the Marie Curie ITN-project: PIC (Personalized Cardiology)
- As coordinator of the Marie Curie ITN-project: HiPerNav (High Performance soft-tissue Navigation), start date 01.11.2016

Collaborations

- University of Bern (ARTOrg)
- Technical University of Delft (TUDelft)
- University Paris13
- University of Cordoba
- Cascination AG
- Inselspital, University of Bern
- INRIA
- SIEMENS
- University of California, San Diego (UCSD)
- University of Dundee
- University of St. Andrews
- Norwegian University of Science and Technology
- University of Homburg, SAAR
- MR Comp GmbH
- GE Medical Systems
- Katholieke Universiteit Leuven, Leuven, Belgium
- Zürcher Hochschule für Angewandte Wissenschaften, Winterthur, Switzerland
- Imperial College London, London, United Kingdom
- Institute of Biomechanics, Center of Biomedical Engineering, Graz, Austria
- Endosense SA, Geneva, Switzerland
- Scuola Superiore Sant'Anna, Pisa, Italy
- University of Verona
- Tallin University
- San Raffaele Hospital
- Yeditepe University
- ETH Zurich
- King's College London
- University of Oxford
- GE Vingmed
- Sintef Medical Technology
- Sheffield Hallam University
- Universidad de Zaragoza
- Universidad Politecnica de Madrid

3.4 MR guided High Intensity Focused Ultrasound treatment

Group Leader: Ragnhild Marie Undseth, MD, PhD

Group Members

Torill Kristin Vadset MD, researcher
Kirsten Hald MD, PhD
Tryggve Storås, PhD, The Intervention Centre (researcher)
Grethe Løvland (technician)
Jorunn Fraser-Green (technician)
Kenneth O Pedersen (technician)
Per Istre, MD (researcher)
Svein Are Vatnehol (technician and researcher

Associated group members

Eduard Baco, MD,
Dept of Urology, OUS Aker (researcher)
Kirsten Hald, MD, PhD, Dept of Gynecology, OUS Ullevål (researcher)
Ellen Viktil, MD, Dept of Radiology, OUS Ullevål (researcher)
Erik Rud, MD,Phd, Dept of Radiology, OUS Aker (researcher)
Kristina Flor Galtung, Dept of Radiology, OUS Aker (researcher)
Johann Baptist Dormagen, MD, PhD, Dept of Radiology OUS Ullevål (researcher)
Bjørn Edwin, Professor MD PhD, The Intervention Centre (researcher)

Background

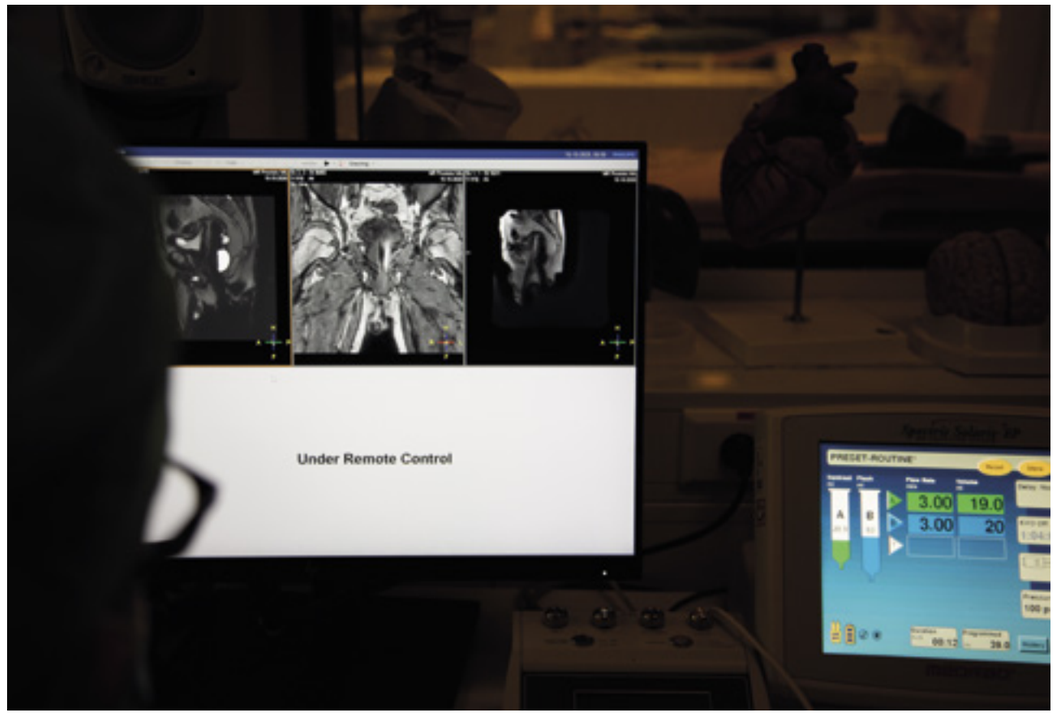
High Intensity Focused Ultrasound (HIFU)-therapy is completely non-invasive as the ultrasound energy is delivered outside the body, but focused in defined areas in an organ. MR provides three-dimensional treatment planning and real-time temperature feedback. Integrating HIFU in MR-scanners melds the technology for visualization and treatment, optimize the procedure and increase the therapeutic potential of HIFU treatment. The 3 T MR at the Intervention Centre has integrated HIFU equipment as part of a research agreement with Philips Medical Systems. Focus has been on both basic and clinical research projects.

Projects

- MR guided HIFU in the treatment of uterine fibroids
- Basic research on MR guided HIFU of liver
- Basic research on MR guided HIFU of prostate

Collaborations

Philips Healthcare, The Netherlands:
Dr Thomas Andrea Profound Medical, Canada



3.5 Wireless Biomedical Sensor Network Research Group

Group Leader: Ilangko Balasingham, Professor
Signal Processing Group
Dept. of Electronic Syst. NTNU

Group members

Sr. Researchers
Jacob Bergsland, MD, PhD
Ali Khaleghi, PhD
Abumoslem Jannersari, PhD

Postdoctoral Fellows
Mladen Veletic, PhD
Amir Maghoul, PhD
Noha El-Gananiy, PhD
Hamidreza Arjmandi, PhD

PhD candidates:
Øyvind Janbu, PhD Fellow
Pritam Bose
Mladen Veletic
Pengfei Lu
Hamed Fouladi
Hemin Qadir
Mohammad Albatat
Salman Mahmood
Deepak Palaksha
Muhammad Faheem Awan
Reza Noormohammadi
Fazel Rangrizi
Farrokh Hejri

Research Engineers
Jacobo Salvador Ortiz Hansen
Oleksandr Ievglevskyi

Background

The research group performs fundamental research and development in information and communication technologies, specifically in wireless sensors and systems for applications in diagnosis, minimal invasive therapy, and ambient point of care monitoring. One of the technological focused areas is on ultra low power and reliable wireless implant sensor networks, where the research is on novel transceiver design, low power data processing on chip, and data processing algorithms including machine and deep learning methods for events and anomaly detection, data fusion, etc. Special interest topics are in implantable/ingestible sensors like cardiac pressure sensors, capsule endoscopes, bio-nano scale communications, and nanomachine-to-cell interfaces for stimulation for applications in cardiac, gastrointestinal, and neurodegenerative diseases. Moreover, the group also performs research in patient record and data mining, signal and image processing, and developing novel sensing and imaging systems using electromagnetic waves.

International collaboration

- Prof. Jianqing Wang, Nagoya Institute of Technology, Japan
- Prof. Narcis Cardona, Universitat Politècnica de València, Spain
- Prof. Ram Narayanan, Penn State University, USA
- Prof. Wout Joseph, Ghent University, Belgium
- Prof. Dirk Pletemeier, Technical University of Dresden, Germany
- Prof. Ian F. Akyildiz, Georgia Institute of Technology, USA
- Prof. Christopher Contag, Michigan State University/Stanford University, USA

3 RESEARCH GROUPS

Selected Externally Funded Research Projects

1. Project Manager/Principle Investigator of Communication Theoretical Foundation of Wireless Cardiac Nanonetworks (CIRCLE). (Funded by the Research Council of Norway, FFRINATEK, 01.09.2019-30.08.2023, Award NOK 10 million)
2. Co-Principle Investigator of Next-Generation Theranostics of Brain Pathologies With Autonomous Externally Controllable Nanonetworks: A Transdisciplinary Approach With Bio-Nanodevices Interfaces (GLADIATOR), (Funded by the European Commission H2020:Future Emerging Technologies (FET) Open Program, 01.01.2019-31.12.2022, award € 5.9 million)
3. Project Manager/Principle Investigator of Development of Real-time Automatic Polyp Detection Systems in Colonoscopy, (Funded by Health South East Trust, Innovation Program, 01.09.2018-31.08.2019, award NOK 0.5 million)
4. Principle Investigator of High Data-Rate Wireless Communication for Deep Medical Implants, (Funded by the Research Council of Norway, FORNY program, 01.01.2018 - 01.05.2020, award NOK 5 million)
5. Project Manager/PI of Wireless In-body Sensor and Actuator Networks (WINNOW). (Funded by the Research Council of Norway, IKTPLUSS, 01.04.2017-30.04.2022, Award NOK 16 million)
6. Coordinator/PI of Wireless In-Body Environment (WiBEC), (Funded by the European Commission, H2020- MARIE Skodowska-CURIE ACTIONS (MSCA-ITN-2015), 01.01.2016-31.12.2019, budget €3.957 million)

3.6 Research Group for Industry Sponsored Studies

Group Leader: Karl Øyri, PhD

Background

In 2019 more than 20 new project inquiries from companies were made specifically to the TestBed. 11 projects were completed in 2019, and 9 are in the pipeline. Sponsors span from small start-up to large international companies. Complex projects involving early phase technologies often have long planning phases due to protocol development and adjustments, regulatory requirements and resource mapping at the hospital.
Inven2, the technology transfer office (TTO) at Oslo University Hospital handles legal contracts and economy for the industry-sponsored projects in the testbed. We continue the close collaboration with Norway Healthech. SMI is regularly present at Aleap in Forskningsparken to meet with companies and Norway Health Tech.
The quality coordinator in SMI is continuously involved in refinement of the quality systems at The Intervention Centre. A God Clinical Practice (GCP) framework has been implemented in the Quality System, and can be used if companies are in need of GCP compliant services.

Ongoing research projects

1. 1 Nordic Proof provides test services for new and innovative healthcare products in the Nordic region. With a “one point of contact” for all the test beds, Nordic proof aim to match provide the companies with a variety of test facilities to meet industry needs.
2. Contiua Certified Bluetooth Low Energy Medical Sensor Network is an innovation project funded by HelseSør-Øst Regional Health Authority. Partners are Acando, Vitir and Bitvis.

Collaborations

The Institutions

- Inven2 TTO
- Innovasjonsavdelingen, Oslo University Hospital
- Norway Health Tech
- Sunnaas Sykehus
- Nordic Medtest, Karlstad, Sweden
- SLL Innovation, Stockholm Läns Landsting, Stockholm, Sweden
- HUS, Hospital District of Helsinki and Uusimaa, Helsinki, Finland
- VihTek, Capital Region of Denmark, Copenhagen, Denmark

Private industry

- Acando
- Vitir
- Bitvis

3 RESEARCH GROUPS

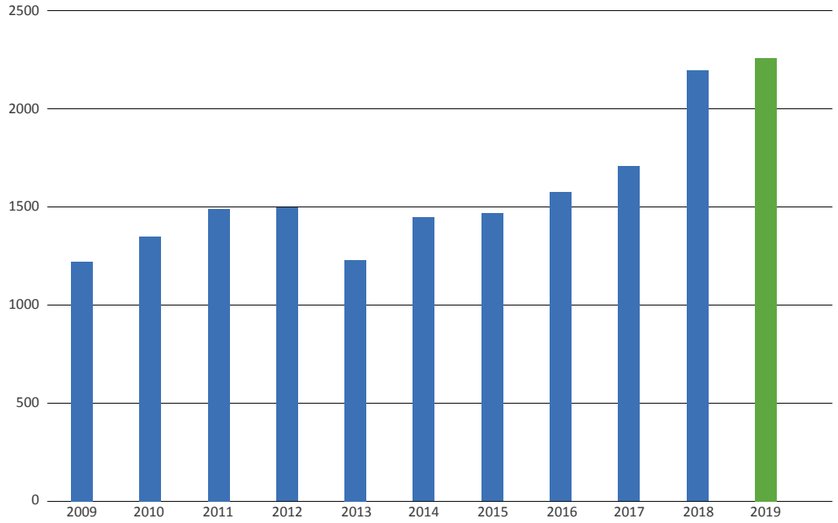
3.7 BigMed

Project leader: Vibeke Binz Vallevik

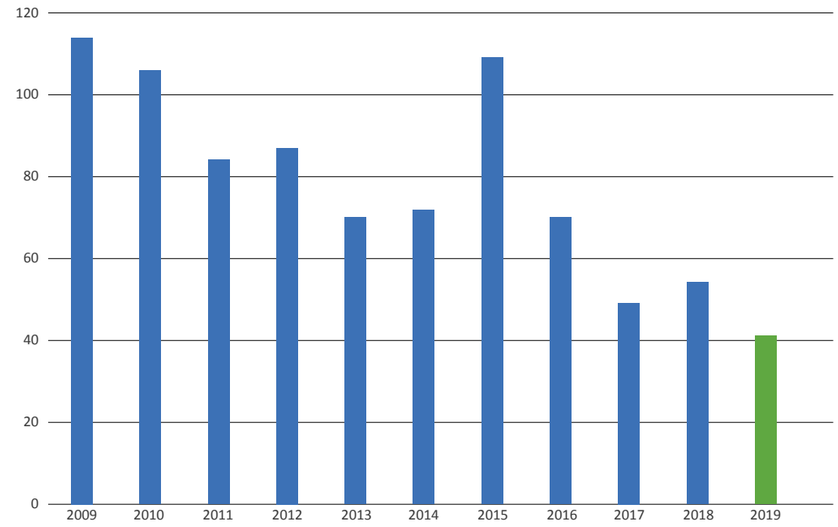
The BigMed project is an ICT Lighthouse project funded by The Research Council of Norway to promote development and technology and services with advanced computer science. The project is managed and owned by the Intervention Centre at Oslo University Hospital, and includes a broad consortium of partners from several other departments in the hospital, three faculties at the University of Oslo, industry organisations and four patient associations. The project aims to lay a foundation for implementing precision medicine and big data analytics in healthcare, and will do so through testing and developing of ICT solutions to support the implementation of precision medicine in three clinical areas: rare diseases, sudden cardiac death and metastatic colorectal cancer. When developing solutions, the cross-competence teams in BigMed identify barriers and actions to overcome them. The 2018 BigMed report (downloadable from www.bigmed.no) summarizes the barriers for implementation of precision medicine, also including legal, ethical and social aspects.

4.1 Clinical activity

PATIENTS AND RESEARCH SUBJECTS AT THE INTERVENTION CENTRE

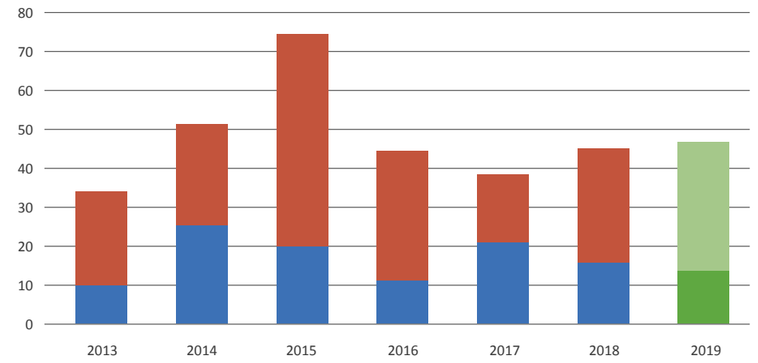


RESEARCH ANIMALS AT THE INTERVENTION CENTRE

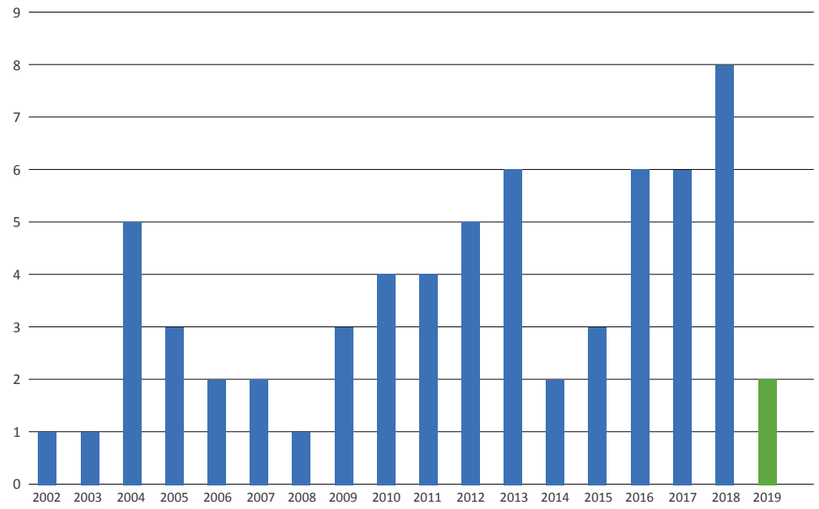


4.2 Publications

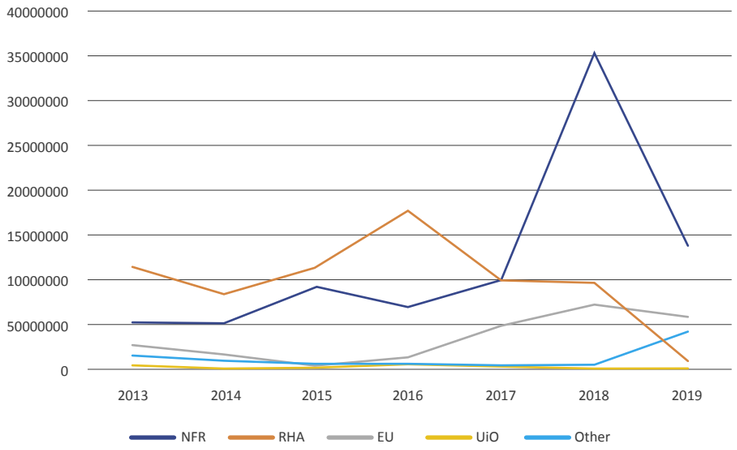
PUBLICATIONS LEVEL 1 (TOP), LEVEL 2 (BOTTOM)



PHD´S AT THE INTERVENTION CENTRE



EXTERNAL RESEARCH FUNDING



4 STATISTICS

4.3 Financial statements

FUNDED BY OUS (NOK)

CATEGORY	BUDGET	2019
Operating expences	7 595 000	8 245 000
Payroll expences	31 153 000	30 794 000
Total	38 748 000	39 039 000

RESEARCH FUNDED (NOK)

SOURCE		2019
Norwegian Research Council NFR		13 653 000
Regional Health Authority HSØ		7 774 000
European Commission EU		6 024 000
University of Oslo UiO		-
Norwegian Cancer Society		2 695 000
Other public foreign		58 000
Other public Norwegian		447 000
TestBed		223 000
Total		30 874 000

5.1 Level 2

1. *Lof S, Korrel M, van Hilst J, Moekotte AL, Bassi C, Butturini G, Boggi U, Dokmak S, Edwin B, Falconi M, Fuks D, de Pastena M, Zerbi A, Besselink MG, Abu Hilal M;* European Consortium on Minimally Invasive Pancreatic Surgery (E-MIPS) (2019).
Outcomes of Elective and Emergency Conversion in Minimally Invasive Distal Pancreatectomy for Pancreatic Ductal Adenocarcinoma: An International Multicenter Propensity Score-matched Study. Ann Surg. 2019 Dec 10.

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Multicentre analysis of the learning curve for laparoscopic liver resection of the posterosuperior segments
Br J Surg, 106 (11), 1512-1522

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The developing athlete's heart: a cohort study in young athletes transitioning through adolescence
Eur J Prev Cardiol, 26 (18), 2001-2008

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Mixed reality holograms for heart surgery planning: first user experience in congenital heart disease
Eur Heart J Cardiovasc Imaging, 20 (8), 883-888

5. *Bøen E, Hjørnevik T, Hummelen B, Elvsåshagen T, Moberget T, Holtedahl JE, Babovic A, Hol PK, Karterud S, Malt UF (2019)*
Patterns of altered regional brain glucose metabolism in borderline personality disorder and bipolar II disorder
Acta Psychiatr Scand, 139 (3), 256-268

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Can we ablate liver lesions close to large portal and hepatic veins with MR-guided HIFU? An experimental study in a porcine model
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Intact responses to non-drug rewards in long-term opioid maintenance treatment
Neuropsychopharmacology, 44 (8), 1456-1463

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Quality of life from a randomized trial of laparoscopic or open liver resection for colorectal liver metastases
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Intravenous Patient-controlled Analgesia Versus Thoracic Epidural Analgesia After Open Liver Surgery: A Prospective, Randomized, Controlled, Noninferiority Trial
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Estimating Regional Myocardial Contraction Using Miniature Transducers on the Epicardium
Ultrasound Med Biol, 45 (11), 2958-2969

11. *Owe KM, Støer N, Wold BH, Magnus MC, Nystad W, Vikanes ÅV (2019)*
Leisure-time physical activity before pregnancy and risk of hyperemesis gravidarum: a population-based cohort study
Prev Med, 125, 49-54

12. *van der Poel MJ, Barkhatov L, Fuks D, Berardi G, Cipriani F, Aljaiuossi A, Lainas P, Dagher I, D'Hondt M, Rotellar F, Besselink MG, Aldrighetti L, Troisi RI, Gayet B, Edwin B, Abu Hilal M (2019)*
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Proc. IEEE, 107 (7), 1425-1441

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1. *Willard CD, Kjaestad E, Stimec BV, Edwin B, Ignjatovic D;* RCC Study Group. Preoperative anatomical road mapping reduces variability of operating time, estimated blood loss, and lymph node yield in right colectomy with extended D3 mesenterectomy for cancer. Int J Colorectal Dis. 2019 Jan;34(1):151-160. Epub 2018 Nov 1.

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Laparoscopic versus open liver resection in the posterosuperior segments: a sub-group analysis from the OSLO-COMET randomized controlled trial
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5. *Aghayan DL, Kalinowski P, Kazaryan AM, Fretland ÅA, Sahakyan MA, Røsok BI, Pelanis E, Bjørnbeth BA, Edwin B (2019)*
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9. *Dahle G, Helle-Valle T, Beitnes JO, Espinoza A, Halvorsen PS, Rein KA (2019)*
Single-centre first experience with transapical transcatheter mitral valve replacement with an apical tether: factors influencing screening outcomes
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10. *Edeklev CS, Halvorsen M, Løvland G, Vatnehol SAS, Gjertsen Ø, Nedregaard B, Sletteberg R, Ringstad G, Eide PK (2019)*
Intrathecal Use of Gadobutrol for Glymphatic MR Imaging: Prospective Safety Study of 100 Patients
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Induction Of Labor Among Singleton Pregnancies In Six Palestinian Governmental Hospitals: A Population-Based Cohort Study
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18. *Karlsen H, Bergan HA, Halvorsen PS, Sunde K, Qvigstad E, Andersen GØ, Bugge JF, Olasveengen TM (2019)*
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19. *Kazaryan AM, Aghayan DL, Barkhatov LI, Fretland ÅA, Edwin B (2019)*
Laparoscopic Multiple Parenchyma-sparing Concomitant Liver Resections for Colorectal Liver Metastases
Surg Laparosc Endosc Percutan Tech, 29 (3), 187-193

20. *Kazaryan AM, Solberg I, Aghayan DL, Sahakyan MA, Reiertsen O, Semikov VI, Shulutko AM, Edwin B (2019)*
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Nano Commun.Netw., 22, 100270
DOI 10.1016/j.nancom.2019.100270, WoS 000498804400001 (Details)

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Energy-efficiency of Cardiomyocyte Stimulation with Rectangular Pulses
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Women's satisfaction with midwife-led continuity of care: an observational study in Palestine
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Improving Maternal and Neonatal Health by a Midwife-led Continuity Model of Care - An Observational Study in One Governmental Hospital in Palestine
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Use of mixed reality for improved spatial understanding of liver anatomy
Minim Invasive Ther Allied Technol

30. *Pischke SE, Hestenes S, Johansen HT, Fure H, Bugge JF, Espinoza A, Skulstad H, Edvardsen T, Fosse E, Mollnes TE, Halvorsen PS, Nielsen EW (2019)*
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Polyp Detection and Segmentation using Mask R-CNN: Does a Deeper Feature Extractor CNN Always Perform Better?
INT SYM MED INFORM, 181-186

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Neural Response Analysis for Brain-Machine Interfaces
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The effect of intraoperative imaging on surgical navigation for laparoscopic liver resection surgery
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MAGMA

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Precision of T1-relaxation time measurements in the hepatic portal vein: influence of measurement technique and sequence parameters
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Multiscale deep desmoking for laparoscopic surgery
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Mechanism of Abnormal Septal Motion in Left Bundle Branch Block: Role of Left Ventricular Wall Interactions and Myocardial Scar
JACC Cardiovasc Imaging, 12 (12), 2402-2413

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Editorials

5.3 PhD Theses

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2. B*jørnelv, Gudrun Maria Waaler.* Health Care Utilization, Costs and Benefits of Treatment in Metastatic Colorectal Cancer. Faculty of Medicine, University of Oslo; 2019

Oslo University Hospital

THE INTERVENTION CENTRE

ANNUAL REPORT 2019

Division of Emergencies and Critical Care, Oslo University Hospital and Institute of Clinical Medicine, University of Oslo

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www.oslo-universitetssykehus.no

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