Oslo University Hospital

Annual report 2020

The Intervention Centre

Division of Emergencies and Critical Care, Oslo University Hospital

CONTENT

ANNUAL REPORT 2020

The Intervention Centre

ANNUAL REPORT 2020
More information: www.ivs.no

PUBLISHER: Oslo University Hospital
EDITOR: Karl Øyri

PHOTO: The Intervention Centre
LAYOUT: Byråservice AS

1 MANAGERS REPORT

In 2020 the Intervention Centre proved itself as a cross-disciplinary research center. Four EU projects were managed by the Centre. The Norwegian Research Council Lighthouse project, BIGMED was in its last year. The number of PhD graduates reached an all-time high with 10 graduates, six from the faculty of Medicine, three from the The Faculty of Mathematics and Natural Sciences at the University of Oslo, and one from the Faculty of Information technology and electrical engineering at the Norwegian University of Science and Technology in Trondheim. The themes of the theses spanned from sensor research and communication to advanced imaging research, from laparoscopic liver surgery to organization of midwifery services in Palestine and introduction of transcatheter aortic valve replacement in Norway.

The variety of topics and disciplines involved all the eminent research groups at the Intervention Centre and also the national and international network that has been built over 24 years as a scientific institution. The seven research groups of the Centre cover a broad range of topics that together constitute the core research identity of the Intervention Centre.

We are particularly proud of the formalized collaboration with the Norwegian University of Science and Technology in Trondheim, and with four different Faculties at the University of Oslo, The Medical Faculty, The Faculty of Mathematics and Natural Sciences, The Faculty of Social Sciences, and the Faculty of Law.

The BIGMED project provided a research platform where the limitations of the existing health legislation in governing the use of digital health information were identified. In the fall 2020, the Ministry of Health suggested a revision in the Health Personnel act and the Health Records act to facilitate the use of patient records data for collaboration, learning and use of artificial intelligence in the health care services. The participation of the Faculty of Law in this work was fundamental for bringing the results from the study to actual legal revisions by the parliament.
The Department of Psychology at the Faculty of Social Sciences has been a main research partner of the Intervention Centre and Oslo University hospital for many years. Through this collaboration we have jointly acquired two MRI laboratories available for brain and other imaging research. Both the MRIs are increasingly being used for the development of new image guided treatment procedures at our Centre.

The two MR laboratories are part of the nine advanced OR room for both human and animal procedures at the Centre. These rooms serve several purposes: Development of new methods for treatment, imaging research and testing of new medical technologies. Traditionally, the MR imaging research, both in collaboration with the Department of Psychology and other research groups constitute more than 60% of the total activity in the Centre. Due to the Covid-19 pandemic and the restrictions introduced by the Norwegian Health authorities, many of these projects had to be put on hold in 2020. Thus, as can be seen form the statistics, the total number of patients and research subjects to the Centre, was reduced from 2362 in 2019 to 2039 in 2020, the reduction was due to a reduction of imaging procedures in the MRs from 1488 to 1002, whereas the number of interventions and surgeries increased from 865 to 1025.

Due to the expansion of the Centre in 2019 the Intervention Centre in 2020 could offer some of the most advanced ORs for use by the Norwegian medical community in their strive to optimize patient treatment. 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 400 Trans-catheter aortic valve interventions (TAVI) were performed in the angiographic hybrid rooms. Advanced aortic stenting, often with fenestrated graft sometimes comprising the aortic arch has also become a routine procedure.

Introduction of advanced imaging technology integrated with navigation systems has allowed a number of new procedures at the Centre:

Image guided scoliosis surgery – the Orthopedic Department performed correction of spinal deformities with Dyna CT assistance in the new hybrid room by the use of the Brainlab navigation system. By the end of surgery the can document the result with the mobile Siemens Prisma CT scanner, available in this particular operating room.

HIFU prostate – The department of Urology run a study to compare MR-guided High intensity focused ultrasound ablation of prostate cancer with robotic prostatectomy; the patients are randomized for either treatment.

CT assisted, MRI guided laser ablation of the brain – In this project, the neurosurgeons use the Visualise system of Medtronic to ablate epileptic foci by MRI guidance. The laser probe is placed in the brain with CT guidance before the patient is moved into the MR for the actual ablation. At the Intervention Centre, the special arrangement with an OR with a movable CT scanner adjacent to a MRI lab connected with sliding doors, makes this type of procedure easy, safe, and time-efficient.

CT and ultrasound guided RF ablation of liver tumors. By using the OR room with the Prisma CT, we can perform ultrasound guided ablation of liver tumors. Alone, or in combination with laparoscopic resection.

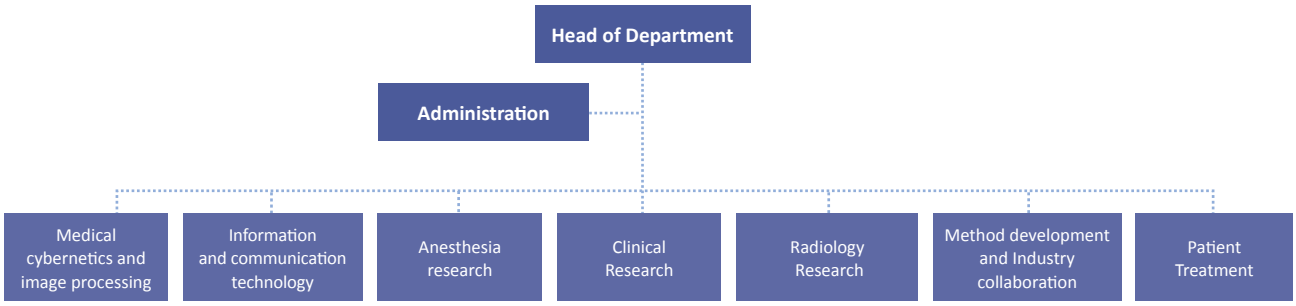
Through our collaboration with Norway Health tech, the Intervention Centre provide test bed facilities and support for pre- clinical and clinical trials. Through the Nordic initiative Nordic Poof – connecting university hospitals in Finland, Iceland, Denmark, Sweden and Norway, the Scandinavian university hospitals can offer a robust test environment to the health care industry worldwide. Nine requests from industry for clinical trials of new technology were received in 2020.

Erik Fosse, Head of Department

2 ORGANIZATION

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 facilitating 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.

2.3 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 PhD 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, (replaced by Mai Eide Frey in 2020)
Special advisor Economy and Quality
Linda Engvik, Operation room coordinator
Kjersti Wendt, Research coordinator

2.5 SECTIONS

2.5.1 Section for Clinical Research

Head of Section Bjørn Edwin, Professor, MD

Staff

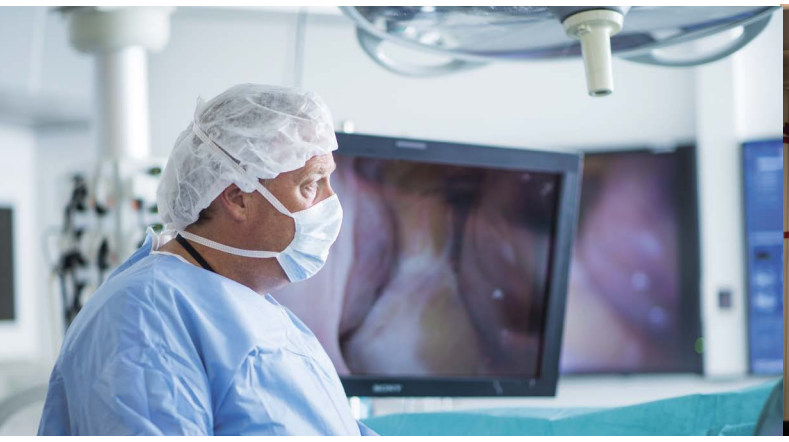
Åsmund Avdem Fretland, consultant surgeon
Lydia Alcacer-Nebot , OR nurse
Randi Ingvild Ingvaldsen, OR nurse
Tina Askelien, OR nurse
Anuska Radeska Skau, OR nurse
Olga Skagseth, OR nurse
Anne Marie Marstein, OR nurse
Victoria Juhasz, Laboratory assistant
Sharon Tamson Andersen, Laboratory assistant
Paula Andrea Rønning, Laboratory assistant
Davit Aghayan, PhD candidate
Egedijus Pelanis, PhD candidate
Mushegh Sahakyan, Post Doc
Heidi Holmen, Post Doc
Knut Ole Sundnes, forsker

Deliveries

- 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.
Alexis G.Hinojosa C, radiographer.
Lisbeth Eriksen, radiographer.
Grethe Løvland, radiographer
Kenneth O. Pedersen, radiographer
Jorunn Fraser-Green, radiographer
Janne Fossen, radiographer
Svein-Are Vatnehol, radiographer
Åshild Gandrud, radiographer
Margrethe Kallestad Rasmussen, radiographer
Mehdi Sadat Akhavi, radiologist
Ragnhild Undseth MD,PhD, radiologist, section manager

Deliveries

- 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.

2.5.3 Section for Anesthesiology Research

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

Staff

Andreas Espinoza, anesthesiologist
Itai Schalit, anesthesiologist
Anton Amalathasan Josephmary, nurse anesthetist
Torill Schou, nurse anesthetist
Guttorm Larsen, nurse anesthetist
Irene Fellie Bjaaland, nurse anesthetist
Helen Littorin-Sandbu , nurse anesthetist
Marit Pettersen, nurse anesthetist
Ole Petter Dahl, nurse anesthetist

Deliveries

- 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


Oslo

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 and Software developer, PhD (OUS, Lecturer NTNU)
Rahul Kumar, Researcher in AI based Liver Image segmentation/Navigation at the BIA-project HoloCare Cloud, 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
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)
Inger Gruenbeck, PhD Fellow, Soft-tissue registration for navigation in Holographic supported orthopedic surgery (Bergesenstiftelsen)
Eirik G. Homlong, Researcher on Gait-analysis using AI (Bergesenstiftelsen)
Matthias Lippert, PhD Fellow, MD cardiology, PhD at the BIA-project HoloCare Cloud validating AI based segmentation algorithms and Hololens applications for the heart
Håvard Solvin, PhD Fellow, MD, Validating Robotic ultrasound examination through the EU-project 5G-Heart

Deliveries

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 timehave 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

The section for Medical Technology Research aims for supporting the clinicians in the OR with new technological methods and new technology.
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 tip of a catheter or in a pill-cam system.

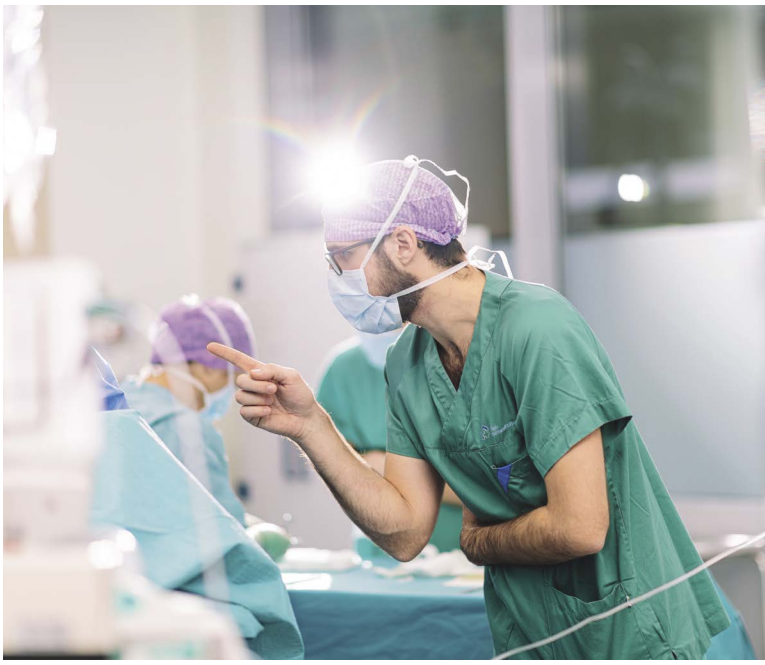
- Explore more research in areas like targeted treatment, new imaging techniques and micro technology.

- 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.



2.5.5 Section for Information and Communication Technology

Head of Section Ilangko Balasingham, Professor

Staff

Senior Researchers

Sr. Researcher Jacob Bergsland, MD, PhD
Associate Professor Ali Khaleghi, PhD
Sr. Researcher Abumoslem Jannesari, PhD

Postdoctoral Fellows and Researchers

Mladen Veletic, PhD
Amir Maghoul, PhD
Noha El-Gananiy, PhD
Hamidreza Arjmandi, PhD
Pritam Bose, PhD
Hemin Qadir, PhD

PhD Students:

Pengfei Lu
Mohammad Albatat
Salman Mahmood
Deepak Palaksha
Reza Noormohammadi
Fazel Rangrizi
Farrokh Hejri
Hamid Khoshfekr Rudsari
Research Engineers
Jacobo Salvador Ortiz Hansen
Oleksandr Ievglevskyi
Nilojan Gnanakulasekaran

Deliveries

- 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 center
- 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 multidisciplinary 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

Deliveries

- 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

- MedTech Trial Work Group

2.5.7 Section for Patient Treatment

Section for Patient Tretament is an administrative section lead by Head of Department professor Erik Fosse. An increasing number of patients from a broad variety of clinics at Oslo University Hospital are treated at The Intervention Centre.

Main figures are described in more detail under chapter 4 Statistics.

3 RESEARCH GROUPS

3.1 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
Stig Ronny Kristiansen, IT-researcher,
Prof. Kjersti Flatmark,
Karl Øyri, PhD
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
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 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.

3.2 MR guided High Intensity Focused Ultrasound treatment

Group Leader: Ragnhild Marie Undseth, MD, PhD

Group Members

Ragnhild Marie Undseth, MD, PhD, radiologist (researcher)
Mehdi Sadat Akhavi, MD, radiologist (researcher)
Bjørn Edwin, Professor MD PhD, The Intervention Centre (researcher)
Tryggve Storås, PhD, The Intervention Centre (researcher)
Grethe Løvland (technician)
Jorunn Fraser-Green (technician)
Svein Are Vatnehol (technician and researcher)

Associated group members

Torill Kristin Vadset MD, researcher
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)
Tina Tellum, MD, PhD, Dept of Gynecology, OUS Ullevål (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

3.3 Clinical and experimental cardiovascular monitoring

Group leader: Professor Per Steinar Halvorsen, 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
Sverre Nestaas, MD, PhD Fellow
Lars Antonsen, MD, PhD Fellow

Associated group members

Professor Leiv Arne Rosseland, MD, PhD
Professor Arnt Fiane, MD, PhD
Espen Remme, MSc, PhD
Noha El-Ganainy. MDc, Pos Doc
Pengfei Lu, MSc, PhD Fellow
Mohammad Albatat, MSc, PhD Fellow
Ali Wadjan, MSc, PhD Fellow

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

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.
- 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.
- Improved detection of hypovolemia and flow impediments during extra corporeal membrane oxygenation. (ECMO)
- Artificial intelligence on continuous vital signs to detect blood loss
- Automated detection of mitral ring velocity and left ventricular strain using artificial intelligence on transesophageal ultrasound recordings.

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.
- Complement Research Group at Oslo University Hospital: Professor Tom Eirik Mollnes and Professor Erik Waage Nielsen
- Department of Computer Science, NTNU: Associate Professor Gabriel Kiss
- Department of Vascular Investigations, Oslo University Hospital. Professor Jonny Hisdal.
- Department of Clinical and Biomedical Engineering, Oslo University Hospital: Researcher Fred Johan Pettersen.

3.4 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, Researcher in AI based Liver Image segmentation/Navigation at the BIA-project HoloCare Cloud
Espen Remme, Senior Researcher in 30% (shared IVS/Kirurgisk forskning), Heart Physiology
Magnus Leon Reinsfelt Krogh, PhD Fellow, Cardiac sensor and signal processing
Egidijus Pelanis, PhD Fellow, HiPerNav and Researcher at the BIA-project HoloCare Cloud validating AI based segmentation algorithms and Hololens applications for the liver
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
Matthias Lippert, PhD Fellow, MD cardiology, PhD at the BIA-project HoloCare Cloud validating AI based segmentation algorithms and Hololens applications for the heart
Håvard Solvin, PhD Fellow, MD, Validating Robotic ultrasound examination through the EU-project 5G-Heart
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)
Inger Gruenbeck, PhD Fellow, Soft-tissue registration for navigation in Holographic supported orthopedic surgery
Eirik G. Homlong, Researcher on Gait-analysis using AI (Bergesenstiftelsen)

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 including AI based methods on segmentation and deformable registration. Visualization and navigation is required to present the medical images to the surgeon intraoperatively. Different visualization techniques such as Mixed Reality visualization are explored. 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.

Some ongoing projects:

EU-project funded:

- As participant of the Marie Curie ITN-project: PIC (Personalized Cardiology)
- As participant of the EU-project 5G-Heart
- As coordinator of the Marie Curie ITN-project: HiPerNav (High Performance soft-tissue Navigation), start date 01.11.2016

Ongoing NFR:

- NorMIT, National Research Infrastructur for Minimally Invasive Treatment
- Analytics for computation and visualization of liver resections (ALIVE), NFR-ICT Pluss
- HoloCare Cloud (BIA/NFR)

Ongoing Helse Sør-Øst:

- Hepa-Navi, Liver Navigation platform (Postdoc)
- Service at OUS – 3D printing of organ models (Innovation)
- Postdoc funded: Planning of surgery on congenital heart diseases using Mixed Reality Visualization and 3D printing
- PhD on Mixed Reality based navigation supported (Hololens) in Orthopedic surgery (Bergesensstiftelsen)

Collaborations

- Phillips
- HoloCare
- 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

3.5 Wireless Sensor Network Research Group

Group Leader: Professor Ilangko Balasingham
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
Pritam Bose, PhD
Hemin Qadir, PhD

PhD Students:
Pengfei Lu
Mohammad Albatat
Salman Mahmood
Deepak Palaksha
Reza Noormohammadi
Fazel Rangrizi
Farrokh Hejri
Hamid Khoshfekr Rudsari

Research Engineers
Jacobo Salvador Ortiz Hansen
Oleksandr Ievglevskyi
Nilojan Gnanakulasekaran

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

Selected Externally Funded Research Projects

1. Principle Investigator/Work Package Leader of Wireless Brain-Connect Interface to Machines (B-CRATOS), (Funded by the European Commission H2020:Future Emerging Technologies (FET) Open Program, 01.03.2021- 28.02.2025, award EUR 4.475 million)
2. Project Manager/PI of Internet of Bio-NanoThings for Prediction and Prevention of Infectious Diseases (CLIPEUS), (Funded by the Research Council of Norway, IKTpluss program, 01.09.2020 - 31.08.2024, award NOK 16 million)
3. Principle Investigator/Work Package Leader of Reliable Technologies and Models for Verified Wireless Body-Centric Transmission and Localization (ROVER) , (Funded by the European Commission H2020-MSCA-RISE, 01.01.2020-31.12.2023, award EUR 1 million)
4. Principle Investigator of 5G HEalth AquaculturE and Transport validation trials (5G-HEART) , (Funded by the European Commission H2020:ICT, 01.07.2019-30.06.2022, award EUR 14.3 million)
5. 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)
6. 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)
7. 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)
8. 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)

3.6 e-Health Research Group

Project leader: Karl Øyri, PhD

Ongoing research projects

1. In 2020 The Clinical Testing Work Group finalized the 2-year innovation project Contiua Certified Bluetooth Low Energy Medical (BLE) Sensor Network. The project was funded by South-East Regional Health Athority. Outcomes were documents describing a Generic BLE Sensor Profile, a Generic BLE Service, and source code for a simplified Genereic BLE sensor.
2. The second project was an innovation project in collaboration with Department for Acute Psychiatry with focus on development of a new platform for monotring of hospitalized psychiatric patientsin collaboration with the company Equanostic AS. The project had funding from the Clinic for Psychiatry.

Collaborations

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

Industry Collaborations

- Nordic Proof

The research group continued the participation in the Nordic Proof, and took part in several web-based marketing meetings addressing private industry in the Nordics.
In total 14 inquiries were processed, and 2 inquiries ended up in collaboration projects.

Industry Collaboration- TestBed

9 companies sent requests for collaboration without entering a collaboration.

Private industry with TestBed projects

- Safe4, (Norway)
- Equanostic AS, (Norway)
- Semcon, (Norway)
- Glucost AS, (Norway)
- Mariner Endoscopy, (Canada)
- NuVera, (USA)
- Siemens Healthineers, (Germany)
- Spinal Stabilization Technologies, (USA)
- Worrell Inc, (USA)

In addition the TestBed was a sub-contractor to multi center projects with

- Pivotal EV ICD, Medtronic (USA)
- ANTHEM HFrEF, Liva Nova (USA)

New ambitions: Development of organizational performance and innovative logistics.

SMI has an ambition to expand its competence and capabilities to a new dimension; how may our experience and competence related to technological innovations be extended to the organizational perspective?

Whereas new solutions from technology research are accelerating, the impact of their implementation will not be achieved at full potential if the involved organizational solutions are unchanged. Despite implementation of numerous new technological solutions in a large span of clinical activities, many services remain organized and operate with a traditional approach that may delay and even obstruct improvements in resource utilization and quality. We have the ambition to identify basic cultural and organizational characteristics that may trigger innovative transformation of clinical services in concordance with technological innovations in a two-fold perspective:

- How may we improve logistics in services which implement new technological solutions?
- How may we extend such experience and logic to clinical services that are not directly involved in the technological development, but where services may replicate and benefit from experiences from more technology based services?

3.7 BigMed Lighthouse Project

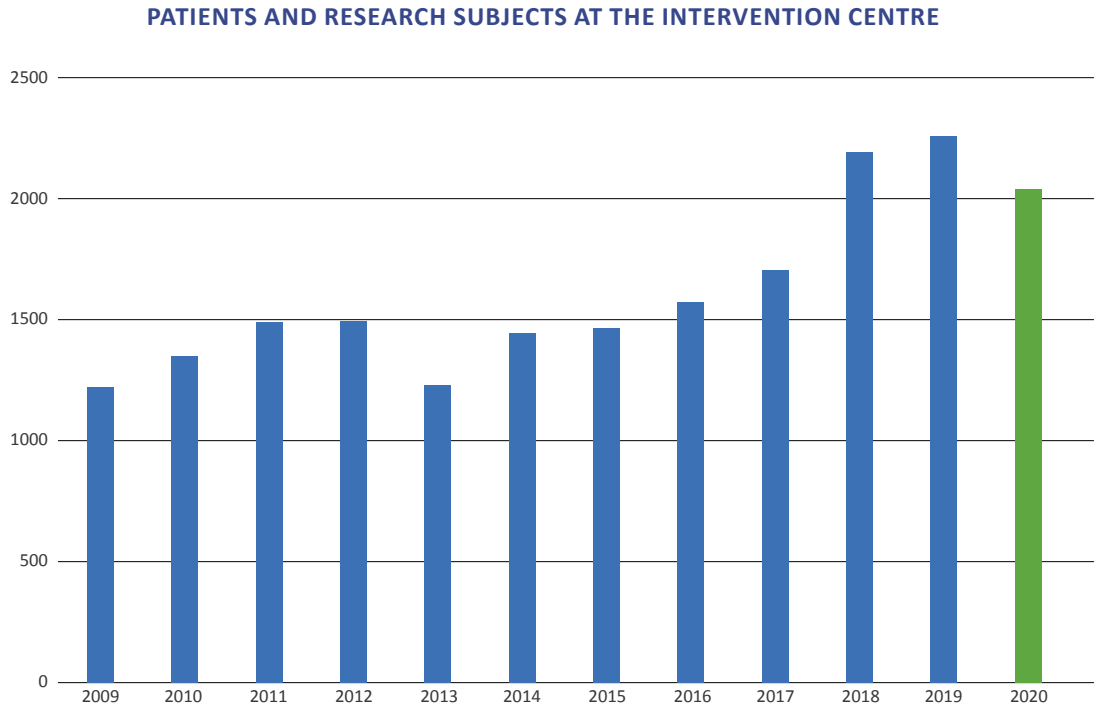
Group Leader: Vibeke Binz Vallevik

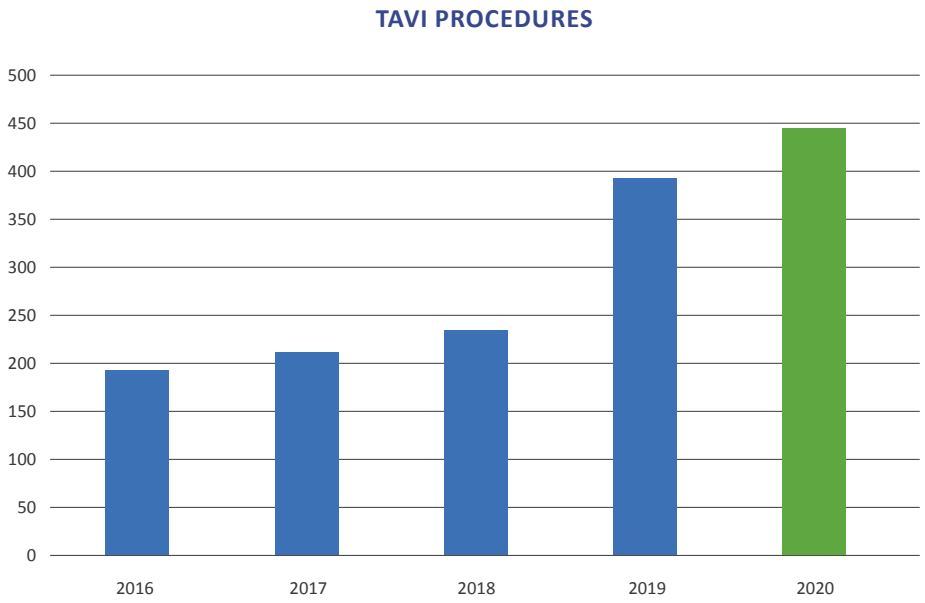
The BigMed project is an ICT Lighthouse project funded by The Research Council of Norway to promote technology development for data driven healthcare. The project is managed and owned by the Intervention Centre at Oslo University Hospital, and includes a broad consortium of partners from several other departments in the hospital, three faculties at the University of Oslo, industry organisations and four patient associations. The project aims to lay the foundation for implementing precision medicine and big data analytics in healthcare, and has done so through testing and developing ICT solutions to support the implementation of precision medicine in three clinical areas: rare diseases, sudden cardiac death and colorectal cancer. When developing solutions, the cross-competence teams in BigMed have identified 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. The project has delivered technical reports, books and papers on several topics within AI and genomics, all available to download at www.bigmed.no/publications. Project seminars discussion the challenges and ways to overcome these are streamed and available for download at www.bigmed.no/events.

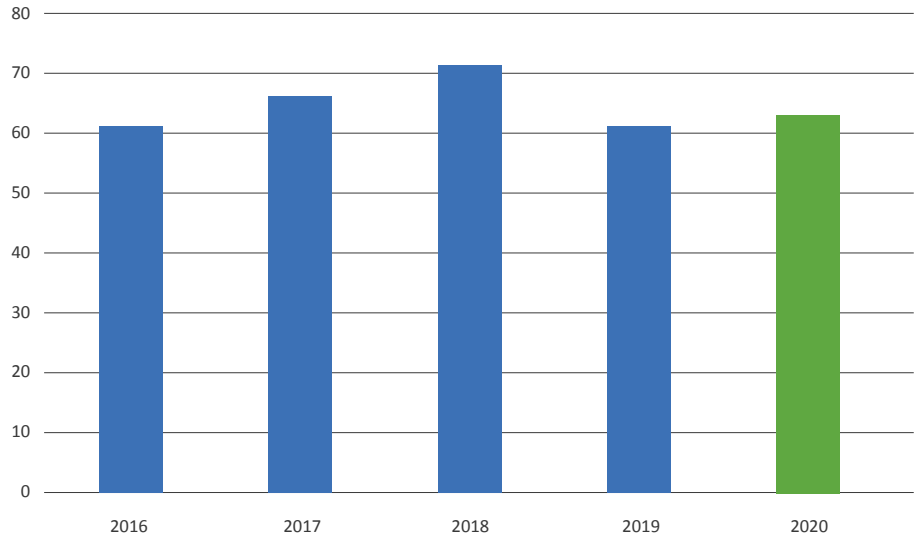
4 STATISTICS

4.1 Clinical activity

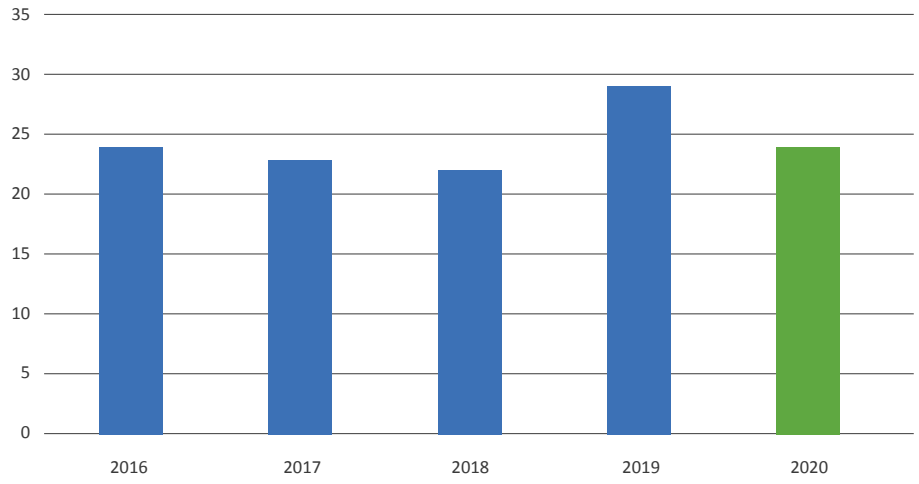




EVAR/TEVAR PROCEDURES

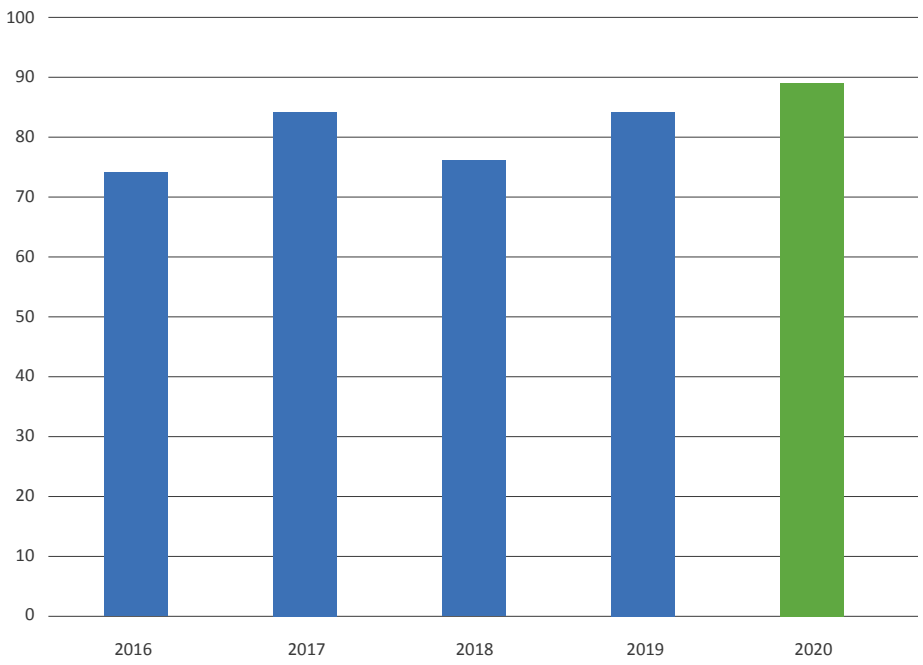


COCHLEAR IMPLANT

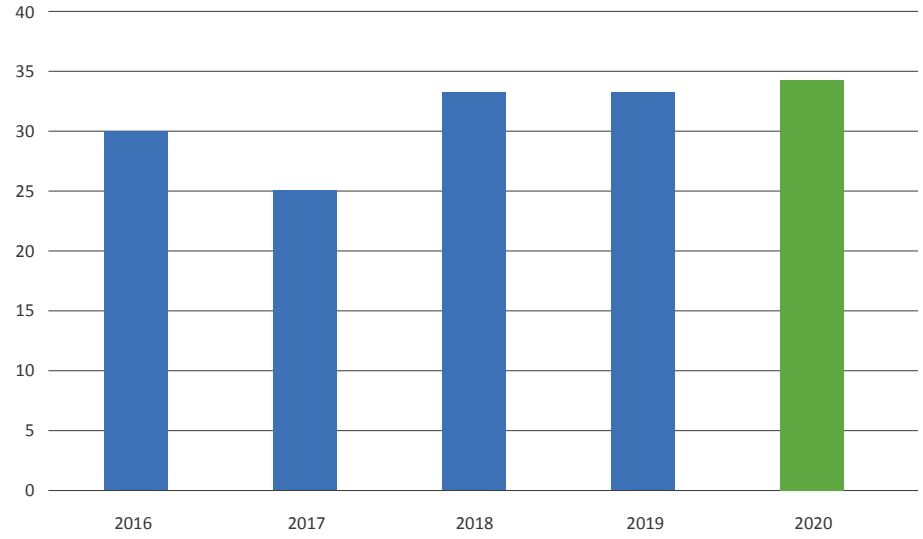


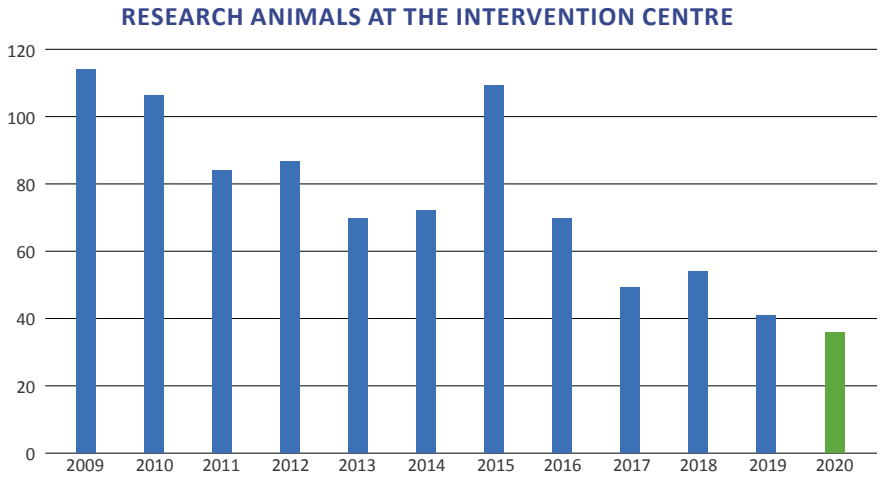
4 STATISTICS

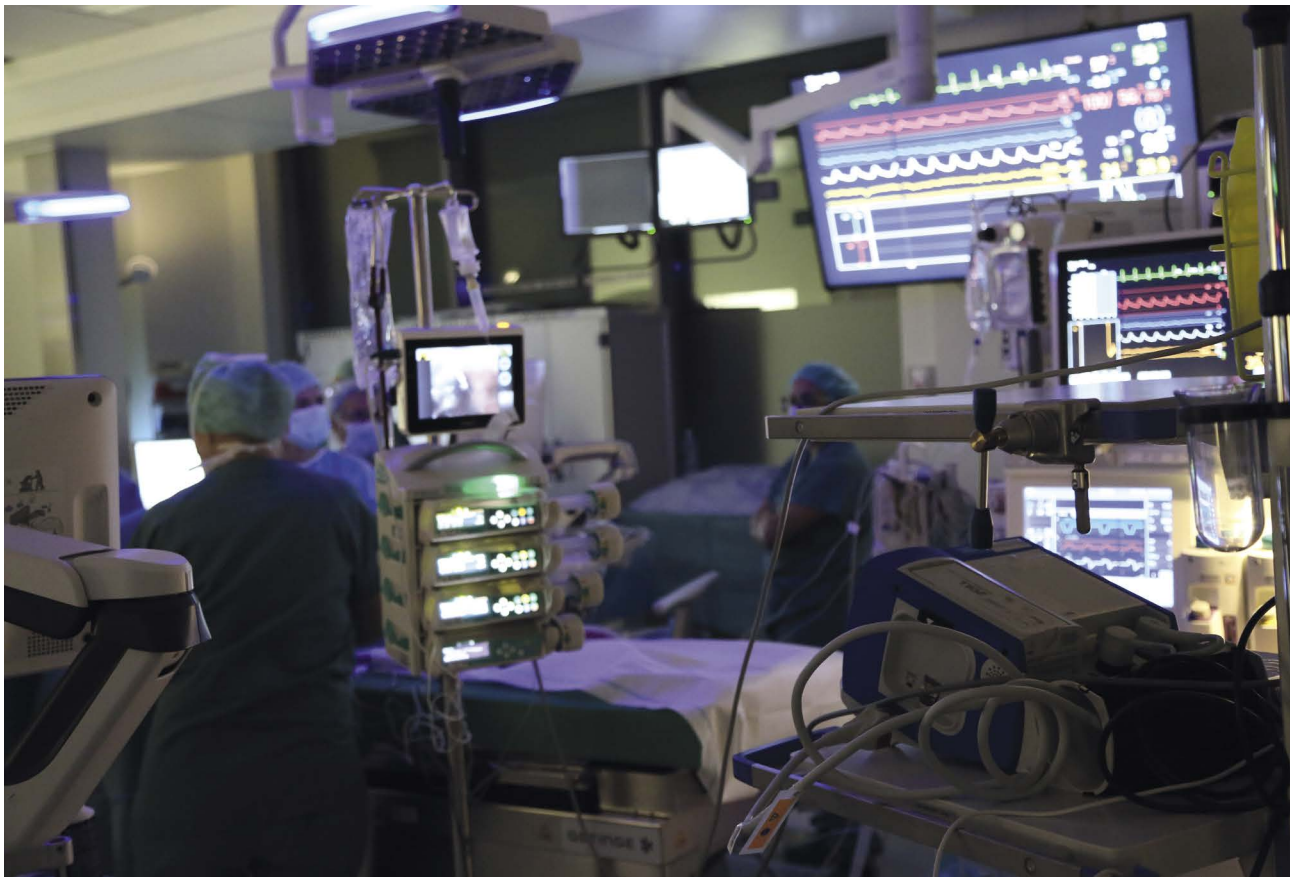
LAPAROSCOPIC LIVER RESECTION



LAPAROSCOPIC PANCREAS RESECTION




RESEARCH ANIMALS AT THE INTERVENTION CENTRE
120
100
80
60
40
20
0
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020



4.2 Financial statements

FUNDED BY OUS (NOK)

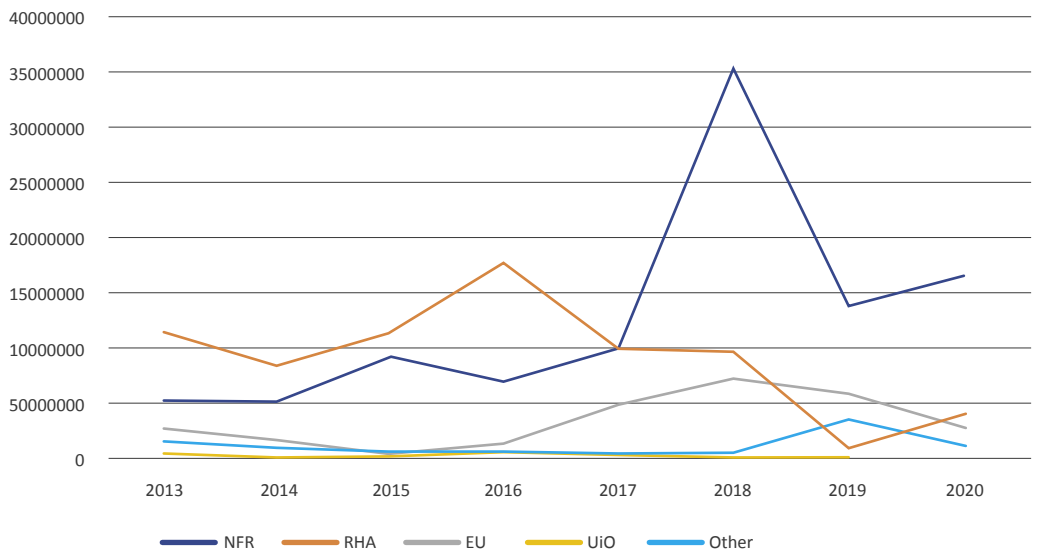
CATEGORY	BUDGET	2020
Operating expences	11 133 000	10 201 000
Payroll expences	34 793 000	36 989 000
Total	**45 926 000**	**47 190 000**

EXTERNAL FUNDING OF RESEARCH

SOURCE		2020
Norwegian Research Council		16 422 159
South-East Regional Health Authority		3 939 000
European Union		2 855 925
University of Oslo		-
Norwegian Cancer Society		
Other public foreign		
Other public Norwegian		1 200 000
TestBed (Industry Collaboration)		687 823
Total		**24 417 084***

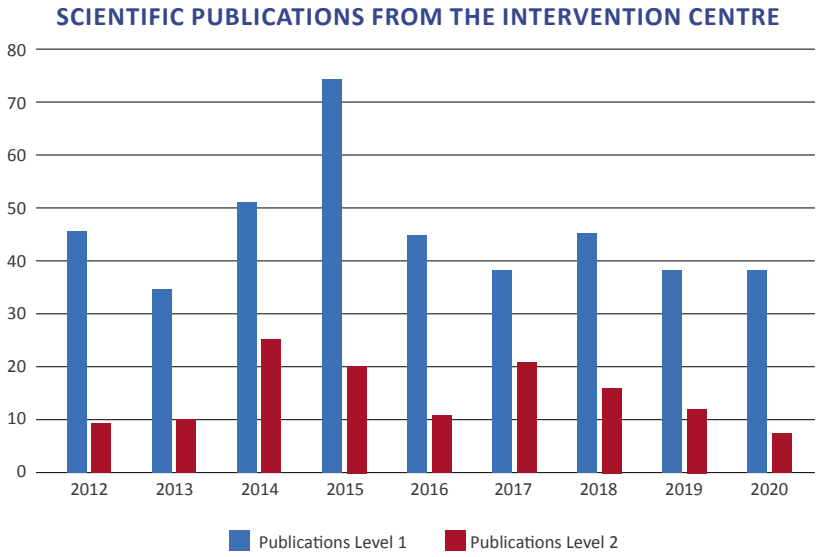
* External funding represents 52% of total spending

EXTERNAL FUNDING SOURCES (NOK)



NFR: Norwegian Research Council, RHA South-East Regional Health Authority, UiO= University of Oslo

5 PUBLICATIONS



5.1 Level 2

1. *Asbun HJ, Moekotte AL, Vissers FL, Kunzler F, Cipriani F, Alseidi A, D'Angelica MI, Balduzzi A, Bassi C, Björnsson B, Boggi U, Callery MP, Del Chiaro M, Coimbra FJ, Conrad C, Cook A, Coppola A, Dervenis C, Dokmak S, Edil BH, Edwin B, Giulianotti PC, Han HS, Hansen PD, van der Heijde N et al. (2020)*
   The Miami International Evidence-based Guidelines on Minimally Invasive Pancreas Resection
   Ann Surg, 271 (1), 1-14

2. *Bjørnelv GMW, Edwin B, Fretland ÅA, Deb P, Aas E (2020)*
   Till death do us part: the effect of marital status on health care utilization and costs at end-of-life. A register study on all colorectal cancer decedents in Norway between 2009 and 2013
   BMC Health Serv Res, 20 (1), 115, 13p

3. *Corral-Acero J, Margara F, Marciniak M, Rodero C, Loncaric F, Feng Y, Gilbert A, Fernandes JF, Bukhari HA, Wajdan A, Martinez MV, Santos MS, Shamohammdi M, Luo H, Westphal P, Leeson P, DiAchille P, Gurev V, Mayr M, Geris L, Pathmanathan P, Morrison T, Cornelussen R, Prinzen F, Delhaas T et al. (2020)*
   The 'Digital Twin' to enable the vision of precision cardiology
   Eur Heart J, 41 (48), 4556-4564

4. *Fong Y, Buell JF, Collins J, Martinie J, Bruns C, Tsung A, Clavien PA, Nachmany I, Edwin B, Pratschke J, Solomonov E, Koenigsrainer A, Giulianotti PC (2020)*
   Applying the Delphi process for development of a hepatopancreaticobiliary robotic surgery training curriculum
   Surg Endosc, 34 (10), 4233-4244

5. *Sahakyan MA, Tholfsen T, Kleive D, Yaqub S, Kazaryan AM, Buanes T, Røsok BI, Labori KJ, Edwin B (2020)*
   Laparoscopic Distal Pancreatectomy Following Prior Upper Abdominal Surgery (Pancreatectomy and Prior Surgery)
   J Gastrointest Surg, 2020 Nov 10, 8p

6. *Vatnehol SAS, Hol PK, Bjørnerud A, Amiry-Moghaddam M, Haglerød C, Storås TH (2020)*
   Effect of Drinking Oxygenated Water Assessed by in vivo MRI Relaxometry
   J Magn Reson Imaging, 52 (3), 720-728

7. *Veletic M, Balasingham I (2020)*
   An Information Theory of Neuro-Transmission in Multiple-Access Synaptic Channels
   IEEE Trans. Commun., 68 (2), 841-853

5.2 Level 1

1. *Albatat M, Bergsland J, Arevalo H, Odland HH, Wall S, Sundnes J, Balasingham I (2020)*
   Multisite pacing and myocardial scars: a computational study
   Comput Methods Biomech Biomed Engin, 23 (6), 248-260

2. *Andersen ØS, Krogh MR, Boe E, Storsten P, Aalen JM, Larsen CK, Skulstad H, Odland HH, Smiseth OA, Remme EW (2020)*
   Left bundle branch block increases left ventricular diastolic pressure during tachycardia due to incomplete relaxation
   J Appl Physiol (1985), 128 (4), 729-738

3. *Arjmandi H, Zoofaghari M, Rouzegar SV, Veletic M, Balasingham I (2020)*
On Mathematical Analysis of Active Drug Transport Coupled With Flow-Induced Diffusion in Blood Vessels
IEEE Trans Nanobioscience, 20 (1), 105-115

4. *Cappelle M, Aghayan DL, van der Poel MJ, Besselink MG, Sergeant G, Edwin B, Parmentier I, De Meyere C, Vansteenkiste F, D'Hondt M (2020)*
A multicenter cohort analysis of laparoscopic hepatic caudate lobe resection
Langenbecks Arch Surg, 405 (2), 181-189

5. *Dagenborg VJ, Marshall SE, Yaqub S, Grzyb K, Boye K, Lund-Iversen M, Høye E, Berstad AE, Fretland ÅA, Edwin B, Ree AH, Flatmark K (2020)*
Neoadjuvant chemotherapy is associated with a transient increase of intratumoral T-cell density in microsatellite stable colorectal liver metastases
Cancer Biol Ther, 21 (5), 432-440

6. *Digernes I, Nilsen LB, Grøvik E, Bjørnerud A, Løvland G, Vik-Mo E, Meling TR, Saxhaug C, Helland Å, Jacobsen KD, Geier O, Emblem KE (2020)*
Noise dependency in vascular parameters from combined gradient-echo and spin-echo DSC MRI
Phys Med Biol, 65 (22), 225020

7. *El-Ganainy NO, Balasingham I, Halvorsen PS, Rosseland LA (2020)*
A New Real Time Clinical Decision Support System Using Machine Learning for Critical Care Units
IEEE Access, 8, 185676-185687

8. *Halvorsen M, Edeklev CS, Fraser-Green J, Løvland G, Vatnehol SAS, Gjertsen Ø, Nedregaard B, Sletteberg R, Ringstad G, Eide PK (2020)*
Off-label intrathecal use of gadobutrol: safety study and comparison of administration protocols
Neuroradiology, 63 (1), 51-61

9. *Hovden IT, Geier OM, Digernes I, Fuster-Garcia E, Løvland G, Vik-Mo E, Meling TR, Emblem KE (2020)*
The impact of EPI-based distortion correction of dynamic susceptibility contrast MRI on cerebral blood volume estimation in patients with glioblastoma
Eur J Radiol, 132, 109278

10. *Jensen K, Hagemo G, Tingberg A, Steinfeldt-Reisse C, Mynarek GK, Rivero RJ, Fosse E, Martinsen AC (2020)*
Evaluation of Image Quality for 7 Iterative Reconstruction Algorithms in Chest Computed Tomography Imaging: A Phantom Study
J Comput Assist Tomogr, 44 (5), 673-680

11. *Kazaryan AM, Aghayan DL, Fretland ÅA, Semikov VI, Shulutko AM, Edwin B (2020)*
Laparoscopic liver resection with simultaneous diaphragm resection
Ann Transl Med, 8 (5), 214, 8p

12. *Khan ZA, Beghdadi A, Cheikh FA, Kaaniche M, Pelanis E, Palomar R, Fretland AA, Edwin B, Elle OJ (2020)*
Towards a Video Quality Assessment based Framework for Enhancement of Laparoscopic Videos
PROC SPIE, 11316, 113160P

13. *Korrel M, Lof S, van Hilst J, Alseidi A, Boggi U, Busch OR, van Dieren S, Edwin B, Fuks D, Hackert T, Keck T, Khatkov I, Malleo G, Poves I, Sahakyan MA, Bassi C, Abu Hilal M, Besselink MG, European Consortium on Minimally Invasive Pancreatic Surgery (E-MIPS) (2020)*
Predictors for Survival in an International Cohort of Patients Undergoing Distal Pancreatectomy for Pancreatic Ductal Adenocarcinoma
Ann Surg Oncol, 28 (2), 1079-1087

14. Krogh MR, Halvorsen PS, Grymyr OHN, Bergsland J, Elle OJ, Fosse E, Remme EW (2020)
Continuous estimation of acute changes in preload using epicardially attached accelerometers
IEEE Trans Biomed Eng, 9p

15. *Larsson C, Groote I, Vardal J, Kleppestø M, Odland A, Brandal P, Due-Tønnessen P, Holme SS, Hope TR, Meling TR, Fosse E, Emblem KE, Bjørnerud A (2020)*
Prediction of survival and progression in glioblastoma patients using temporal perfusion changes during radiochemotherapy
Magn Reson Imaging, 68, 106-112

16. *Liang KX, Vatne GH, Kristiansen CK, Ievglevskyi O, Kondratskaya E, Glover JC, Chen A, Sullivan GJ, Bindoff LA (2020)*
N-acetylcysteine amide ameliorates mitochondrial dysfunction and reduces oxidative stress in hiPSC-derived dopaminergic neurons with POLG mutation
Exp Neurol, 337, 113536, 15p

17. *Lu P, Veletić M, Bergsland J, Balasingham I (2020)*
Theoretical Aspects of Resting-State Cardiomyocyte Communication for Multi-Nodal Nano-Actuator Pacemakers
Sensors (Basel), 20 (10), 20p

18. *Lu PF, Veletic M, Bergsland J, Balasingham I (2020)*
Molecular Communication Aspects of Potassium Intracellular Signaling in Cardiomyocytes
IEEE Access, 8, 201770-201780

19. *Luzon JA, Stimec BV, Bakka AO, Edwin B, Ignjatovic D (2020)*
Value of the surgeon's sightline on hologram registration and targeting in mixed reality
Int J Comput Assist Radiol Surg, 15 (12), 2027-2039

20. *Maldari M, Albatat M, Bergsland J, Haddab Y, Jabbour C, Desgreys P (2020)*
Wide Frequency Characterization of Intra-Body Communication for Leadless Pacemakers
IEEE Trans Biomed Eng, 67 (11), 3223-3233

5 PUBLICATIONS

21. *Nesgaard JM, Stimec BV, Edwin B, Bakka AO, Ignjatovic D, Oresland T, Faerden AE, Thorsen Y, Andersen S, Negaard A, Jacobsen R, von Brandis KML, Hansen T, Suhrke P, Willard CD, Luzon J, Andersen BT, Gaupset R, Bergamaschi R, Pulling F, Baral J, Ruiz MG, Sevinc B, Lindstrom J, Sheikh AE et al. (2020)*
CT and operative images for evaluation of right colectomy with extended D3 mesenterectomy anterior and posterior to the mesenteric vessels
Eur. Surg., 52 (1), 29-36

22. *Palaksha D, Kansanen K, Filippo Z, Bergsland J, Balasingham I, Feuerstein D (2020)*
Patient Specific Strategies to Enhance Leadless Pacemaker Lifetime in Synchronized Dual Chamber System
IEEE Access, 8, 49363-49376

23. *Qadir HA, Balasingham I, Solhusvik J, Bergsland J, Aabakken L, Shin Y.* Improving Automatic Polyp Detection Using CNN by Exploiting Temporal Dependency in Colonoscopy Video. IEEE J Biomed Health Inform. 2020 Jan;24(1):180-193.

24. *Saevik M, Beitnes JO, Aaberge L, Halvorsen PS (2020)*
Safety and feasibility of dobutamine stress echocardiography in symptomatic high gradient aortic stenosis patients scheduled for transcatheter aortic valve implantation
J Clin Ultrasound, 49 (1), 38-48

25. *Sahakyan AM, Aleksanyan A, Batikyan H, Petrosyan H, Sahakyan MA (2020)*
Standard and multivisceral colectomy in locally advanced colon cancer
Radiol Oncol, 54 (3), 341-346

26. *Sahakyan MA, Tholfsen T, Kleive D, Waage A, Buanes T, Labori KJ, Røsok BI, Edwin B (2020)*
Laparoscopic distal pancreatectomy in patients with poor physical status
HPB (Oxford), 2020, 5p

27. *Satpute N, Naseem R, Palomar R, Zachariadis O, Gómez-Luna J, Cheikh FA, Olivares J (2020)*
Fast parallel vessel segmentation
Comput Methods Programs Biomed, 192, 105430, 10p

28. *Kumar RP, Pelanis E, Bugge R, Brun H, Palomar R, Aghayan DL, Fretland ÅA, Edwin B, Elle OJ. (2020)*
Use of mixed reality for surgery planning: Assessment and development workflow Journal of Biomedical Informatics: X. 8:100077. 8p

29. *Schalit I, Espinoza A, Pettersen FJ, Snartland S, Ringdal ML, Hoel TN, Skulstad H, Fosse E, Fiane AE, Halvorsen PS (2020)*
Detection of Thromboembolic Events and Pump Thrombosis in HeartWare HVAD Using Accelerometer in a Porcine Model
ASAIO J, 66 (1), 38-48

30. *Tariverdi A, Venkiteswaran VK, Martinsen ØG, Elle OJ, Tørresen J, Misra S (2020)*
Dynamic modeling of soft continuum manipulators using lie group variational integration
PLoS One, 15 (11), e0242235

31. *Teatini A, Pérez de Frutos J, Eigl B, Pelanis E, Aghayan DL, Lai M, Kumar RP, Palomar R, Edwin B, Elle OJ (2020)*
Influence of sampling accuracy on augmented reality for laparoscopic image-guided surgery
Minim Invasive Ther Allied Technol, 2020 Mar 5:1-10.

32. *Vatnehol SAS, Hol PK, Bjørnerud A, Amiry-Moghaddam M, Haglerød C, Storås TH.* Determination of oxygen r(1) at 3 Tesla using samples with a concentration range of dissolved oxygen. Magma (New York, NY). 2020;33(3):447-53.

33. *Veletic M, Barros MT, Arjmandi H, Balasubramaniam S, Balasingham I (2020)*
Modeling of Modulated Exosome Release From Differentiated Induced Neural Stem Cells for Targeted Drug Delivery
IEEE Trans Nanobioscience, 19 (3), 357-367

34. *Wajdan A, Krogh MR, Villegas-Martinez M, Halvorsen PS, Elle OJ, Remme EW (2020)*
Automatic detection of valve events by epicardial accelerometer allows estimation of the left ventricular pressure trace and pressure-displacement loop area
Sci Rep 2020 Nov 18;10(1):20088

35. *Wendt K, Mørk BE, Berg OT, Fosse E (2020)*
Medicine and interest politics a study of decision-making processes in the area of vascular surgery in Norway
J Health Organ Manag, Vol. 34 No. 4, 2020: 427-447

36. *Wisløff-Aase K, Kerans V, Haugaa K, Halvorsen PS, Skulstad H, Espinoza A (2020)*
Changes in left ventricular electromechanical relations during targeted hypothermia
Intensive Care Med Exp, 8 (1), 76, 13p

37. *Zachariadis O, Teatini A, Satpute N, Gómez-Luna J, Mutlu O, Elle OJ, Olivares J (2020)*
Accelerating B-spline interpolation on GPUs: Application to medical image registration
Comput Methods Programs Biomed, 193, 105431, 13p

38. *Satpute N, Naseem R, Pelanis E, Gómez-Luna J, Cheikh FA, Elle OJ, et al.* GPU acceleration of liver enhancement for tumor segmentation. Comput Methods Programs Biomed. 2020;184, 105285, 11p

5.3 PhD Theses

1. *Åsmund Fretland.* Minor Surgery for Major Disease. A Randomzed Controlled Trial of Laparoscopic and Open Liver Surgery. Faculty of Medicine, University of Oslo. 2020

2. *Ulrik Carling.* Image guided treatment of liver tumors – experimental MRgHIFU ablation and drug eluting embolic transarterial chemoembolization. Faculty of Medicine, University of Oslo. 2020

3. *Berit Mortensen.* Making Midwifery Matter -The introduction of a Midwife-led Continuity Model of care in occupied Palestine. Faculty of Medicine, University of Oslo. 2020

4. CongCong Wang. Intra-operative Image Enhancement and Registration for Image Guided Laparoscopic Liver Resection. Faculty of Information technology and electrical engineering. NTNU. 2020

5. *Hemin Qadir.* Development of Image Processing Algorithms for the Automatic screening of Colon Cancer Based on Video Capture. The Faculty of Mathematics and Natural Sciences University of Oslo. 2020

6. *Gry Dahle.* The Introduction of Transcatheter Aortic Valve Implantation (TAVI) - Clinical, patient experience, economical and occupational hazard issues. Faculty of Medicine, University of Oslo. 2020

7. *Kristin Jensen.* Iterative reconstruction in CT imaging; Image quality and radiation doses. The Faculty of Mathematics and Natural Sciences University of Oslo. 2020

8. *Magnus Reinsfelt Krogh.* Combined accelerometer and gyro sensors for continuous left ventricular function monitoring. The Faculty of Mathematics and Natural Sciences University of Oslo. 2020

9. *Svein Are Sirirud Vatnehol.* The potential for MR-relaxometry to evaluate the uptake absorption of oxygen after per oral administration of oxygenated water. Faculty of Medicine, University of Oslo. 2020

10. Davit Aghayan. Laparoscopic parenchyma-sparing surgery in the treatment of colorectal liver metastases. Faculty of Medicine, University of Oslo. 2020

Oslo University Hospital

THE INTERVENTION CENTRE

ANNUAL REPORT 2020

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

www.ivs.no

www.oslo-universitetssykehus.no

Address: Oslo universitetssykehus HF, Postboks 4950 Nydalen, 0424 OSLO • Tel: +47 23 07 01 00 • Fax: +47 23 07 01 10