Oslo University Hospital

Annual report 2018

The Intervention Centre

Oslo University Hospital and Institute of Clinical Medicine, University of Oslo

CONTENT

ANNUAL REPORT 2018

The Intervention Centre

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More information: www.ivs.no

PUBLISHER: Oslo University Hospital
EDITOR: Karl Øyri

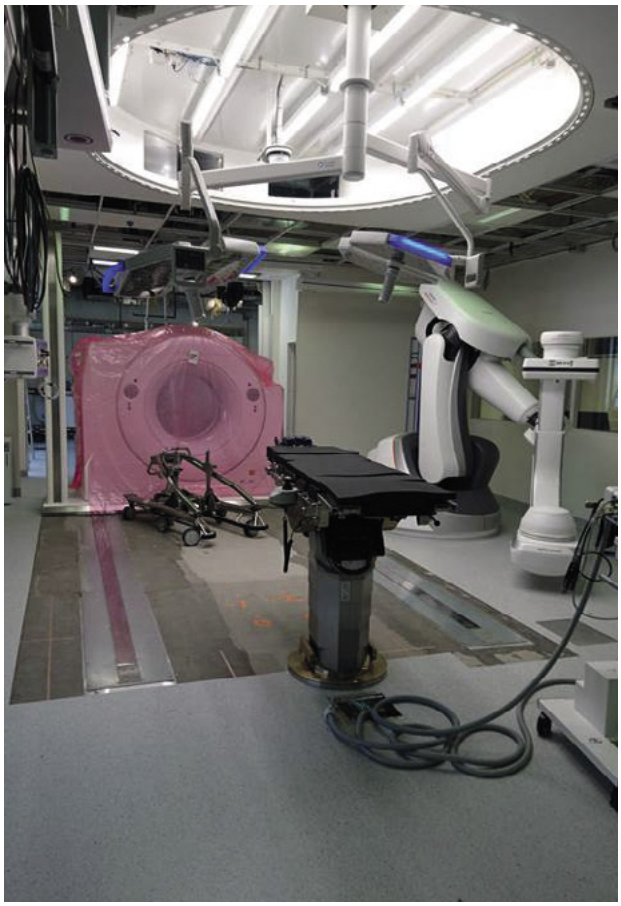
PHOTO: The Intervention Centre
LAYOUT: Byråservice AS

The operation rooms of tomorrow are here today

Tomorrow's medicine will require ORs with advanced imaging equipment. Through the 22 years history of the Intervention Centre we have experienced that more and more patients require hybrid suites of some kind for treatment. The expansion of the Centre that has been planned for some time was thus implemented in 2017 and 2018.

The equipment for the new suites was funded partly by the Norwegian Research Council as a large infrastructure in collaboration with the St Olav hospital in Trondheim, the NorMit project, and partly through collaboration with the Institute for Psychology at the University of Oslo. The expansion was possible through a comprehensive research agreement with Siemens, where we will test patient work flow and impact on clinic and patient experience of treatment in advanced hybrid suite enabling "one stop shop" where diagnostics and treatment can be performed simultaneously.

The new suites consist of a suite containing a Siemens MAGNETOM Prisma – MR System. The rooms is linked with a sliding door to an operation theatre where CT scanning can be performed by a Siemens Somatom definition Edge CT with a sliding gantry that also serve another operation suite also containing an Artis Pheno angiography unit. We can thus provide treatment in a hybrid environment with advanced operation theatres and the latest MR-, CT- and angiography equipment.



1 MANAGERS REPORT

In 2018 the NGO-driven hospital, the Feiring Clinic stopped treating patients with cardiac diseases, resulting in a transferal of the treatment responsibility of more than 300 patients to Oslo University Hospital. Due to the new suites, the Intervention Center could take over the treatment of the patients requiring Trans-catheter aortic valve implantation and also provide suites for some thoracic patients thereby providing the capacity both for interventional treatment and surgery for the Heart and Lung Clinic.

In 2016 together with several partners at the University of Oslo and the University of Science and Technology in Trondheim (NTNU), we were granted a lighthouse project by the Norwegian Research Council. The BigMed project that aims at identifying and eliminating some of the bottlenecks for precision medicine was officially started in March 2017. With a budget of 130 mill NOK and 11 work packages covering the spectrum of clinical, computer science and legal challenges the project is a major national effort to bring precision medicine and advanced decision support into everyday clinical life. The BigMed project proceeded in 2018. The challenge of acquiring patient data for machine learning was highlighted by the implementation of the new EU regulations for patient privacy the GDPR I 2018.

In 2018 The Intervention Centre has been coordinating two Marie Curie actions under the EU Horizon 2020 program, one is the wireless in body Environment project, (WiBEC) and the other HiPerNav developing in body navigation.

1 MANAGERS REPORT

Artificial Intelligence and deep learning algorithms are now central ingredients of most of the projects at the Intervention Centre. We are just glimpsing into the future possibilities and challenges this technology represent for health care.

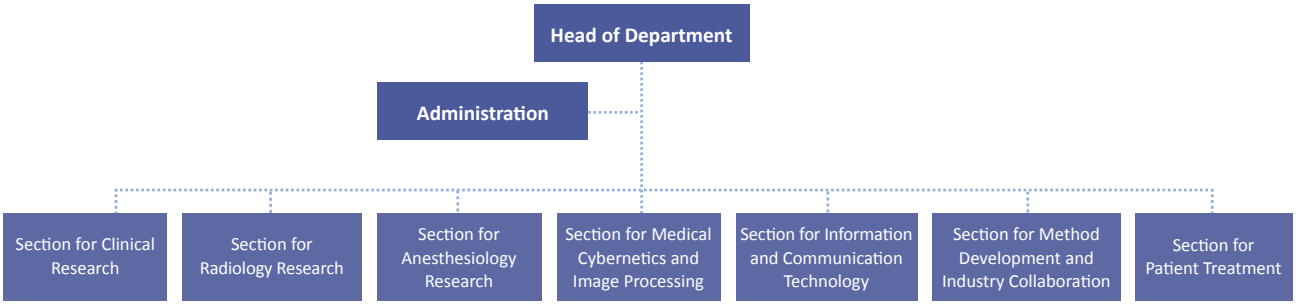
Thus, the technological projects and the BigMed project aim at harvesting and analysing the large amount of data we now are able to acquire for every patient, and which we are under the obligation to implement in clinical practice. Utilizing health data in this way is new, and therefore the legal framework and the technological solutions need to be developed in parallel.

Through our national and international collaboration we can provide an up dated research environment for image guided treatment and artificial intelligence in medicine.

Erik Fosse
Head of The Intervention Centre

2 ORGANIZATION

2.1 Organization map



Department Management

Head of Department Erik Fosse, Professor, MD

Staff

Marianne Berg, Office Manager
Linda Engvik, Nurse Manager

2.2 Section for Clinical Research

Head of Section Bjørn Edwin, Professor, MD

Staff

Åsmund Avdem Fretland, consultant surgeon
Bjørg Scheele, OR nurse
Anne Hege Andreassen, OR nurse
Jennifer Teruel Tamson, OR nurse
Olga Skagseth, OR nurse
Victoria Juhasz, 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

2.3 Section for Radiology Research

Head of Section Ragnhild Marie Undseth, MD, PhD

Staff

Hilde Sofie Korslund, radiographer
Grethe Løvland, radiographer
Kenneth O. Pedersen, radiographer
Jorunn Fraser-Green, radiographer
Martine Minge, radiographer
Till Schellhorn, radiologist
Per Kristian Hol, section manager (until 31.08.2018)

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
- Contribute to innovation and secure intellectual property

2.4 Section for Anesthesiology Research

Head of Section Per Steinar Halvorsen, MD, PhD

Staff

Viesturs Kerans, anaesthetist
Kjersti Wendt, nurse anaesthetist
Anton Amalathasan Josephmary, nurse anaesthetist
Kari Westby, nurse anaesthetist
Torill Schou, nurse anaesthetist
Brita Th. Noorland, nurse anaesthetist
Guttorm Larsen, nurse anaesthetist

Deliverables

- Anesthesia service to all clinical and experimental projects at the Intervention Centre
- Training/supervision of healthcare personnel in new cardiovascular monitoring techniques
- 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 Section for Medical Cybernetics and Image Processing

Head of Section Ole Jakob Elle, Professor, PhD

Staff

Espen Remme, Senior Researcher in 30%, PhD
Rafael Palomar, PhD fellow/Researcher Software (HiG/OUS, MSc)
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.
Pravda Jith Ray, PhD Fellow (HiPerNav)
Andrea Teatini, PhD Fellow (HiPerNav)
Ali Wajdan, PhD Fellow (PIC)
Manuel Villegas, PhD Fellow (PIC)

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 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.

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

2.6 Section for Information and Communication Technology

Head of Section Ilangko Balasingham, Professor

Staff

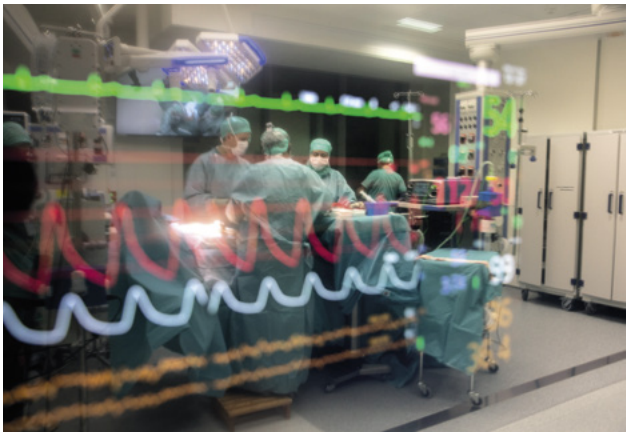
Jacob Bergsland, MD, PhD Sr. Researcher
Ali Khaleghi, PhD Associate Professor
Laura Slaughter, PhD Associate Professor
Knut Korsell, Project manager

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”

2.7 Section for Method Development and Industry Collaboration

Head of Section Karl Øyri, PhD

Staff

Bjørn Tjønnås, Quality Coordinator
Leif-Petter Rustad, Research Coordinator
Karl Arne Johannessen, MD, PhD, Senior Consultant
Dag Hjelle, MD, Senior Consultant

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
- Update of the project database at The Intervention Centre
- 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
- Monthly updates of project database
- Responsible for health economy competence at The Intervention Centre

Research Groups

Clinical Testing Work Group

2.8 Section for Patient Treatment

Head of Section Erik Fosse, professor, MD

This is an administrative section.

3 RESEARCH GROUPS

3.1 Image guided general surgery and intervention

Group Leader: Bjørn Edwin, professor, MD

Group Members

Mushegh Sahakyan PhD, Surgeon
Anne Waage PhD, Surgeon
Knut Jørgen Labori PhD, Surgeon
Stig Ronny Kristiansen, IT-researcher
Karl Øyri, PhD, Researcher
Dejan Ignatovic PhD, Surgeon
B.A. Bjørnbeth PhD, Surgeon
Trond Buanes, Professor
Gudrun Maria Waaler Bjørnelv PhD candidate
Bård Røsok PhD, Surgeon
Airazat Kazaryan PhD, Researcher
Åsmund Avdem Fretland, PhD Fellow
Kjersti Flatmark, professor
Leonid Barkhatov, PhD Fellow
Sven-Petter Haugvik, PhD Fellow
Davit Aghayan, PhD Fellow
Vegard Dagenborg, PhD Fellow
Sheraz Yaqub PhD, Surgeon

Background

Minimally invasive surgery is evolving rapidly, and the need for systematic development and evaluation of these methods is great. Our group focuses on research on the results of new minimally invasive surgical techniques in addition to 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 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
- 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, Dept. of General and Hepato-Biliary Surgery and Liver Transplantation Service, Ghent University Hospital Medical School, Belgium.
Ass. Prof Mohammad Abu Hilal, Faculty of Medicine, Southampton University, Research and development lead for Surgery, Southampton University hospital – Great Britain
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.

Group Members

Kim Ånonsen, PhD Fellow
Gudrun Maria Waaler Bjørnelv, PhD Fellow
Åsmund Avdem Fretland, PhD Fellow
Jens Marius Næssgaard, PhD Fellow
Andrea Teatini, PhD Fellow
Egidijus Pelanis, PhD Fellow
Davit Aghayan, PhD Fellow
Hilde Kjernlie Andersen, PhD Fellow
Vanja Cengija, PhD Fellow
Leonid Barkhatov, PhD Fellow
Ulrik Carling, PhD Fellow
Vegar Dagenborg, PhD Fellow
Javier Luzon, PhD Fellow

3.2 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)
Bjørn Edwin, Professor MD PhD, The Intervention Centre (researcher)

Associated group members

Viktor Berge, MD PhD, and 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)
Johann Baptist Dormagen, MD, PhD, Dept of Radiology 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 RESEARCH GROUPS

3.3 Clinical and experimental cardiovascular monitoring

Group leader: 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

Associated group members

Professor Erik Fosse, The Intervention Centre,

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

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 includes testing in in-vitro and in-vivo and evaluating hemodynamic responses of 1) new cardiovascular image guided procedures, 2) ECMO strategies, 3) treatment for end stage heart failure with ventricular assist devices (VAD). Technologies under investigation for cardiac function monitoring include implantable 3D accelerometers, gyro-, magnetometer-, 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.
- The effects of pulmonary hypertension and interventricular septal shift on left and right ventricular function in septic pigs
- Multifunctional pacemaker systems for cardiac resynchronization therapy (CRT)
- Can beta-blockers improve cardiovascular function and survival after cardiac arrest: an experimental ECMO study
- 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

Collaborations

- The Oslo Cardiopulmonary Resuscitation Research (OSCAR) Network at Oslo University Hospital: Professor K. Sunde
- WiBEC EU-project at The Intervention Centre: Professor Ilangko Balasingham,
- 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

3.4 Value-based and International Health Care Research

Group Leader: Professor Erik Fosse
Institute for Clinical Medicine, UIO

Group members

Sr. Researchers
Marit Lieng, MD, PhD
Katariina Laine, MD, PhD
Bjørn Erik Mørk, PhD
Ole Berg, PhD
Karl Arne Johannessen, MD PhD
Thomas Smedsrud, MD
Knut Korsell, MSc

PhD candidates 2018:
Brith Andresen, PhD Fellow
Hadeel Ali, PhD Fellow
Mohammed Zimmo, PhD Fellow
Kaled Zimmo, PhD Fellow
Kjersti Wendt, PhD Fellow
Berit Mortensen, PhD Fellow
Gry Dahle, PhD Fellow

Background

Most The research group performs research on changes in health organization deriving from new technological developments and new training. The group performs research both in Palestine and in Norway. In Palestine, the research is about birth complications. In Norway the group focus on the value consequences of catheter-based valve implantation and interventional radiology in vascular surgery.

Implementing new UAV-technology in transportation of biological and other material between hospitals is a main topic of the research group, as well as defining the bottlenecks in applying artificial intelligence in promoting precision medicine.

The work involves exploring new technologic solutions in training of health personnel, in hospital logistics and in diagnostics and treatment posing the following questions:

Is it harmful to the patients?
Is it better than existing methods?
For everyone or sub groups only?
In what way is it better?
Better clinical outcome (survival, morbidity)
Same clinical outcome, but fewer burdens to the patient
Same clinic, same burden, but cheaper
Consequences for health care organization
Favorable clinical, patient experienced or economical outcome dependent on change in organization
Consequences for society's prioritization
More expensive for the hospital, but cheaper for society
More expensive for the hospital and society, but better for the patient

Selected Externally Funded Research Projects

- BIGMED: a big data medical solution for precision medicine
- Outcomes in patients and their closest relatives treated for congenital heart disease with catheterbased and surgical techniques
- The Introduction of Transcatheter Aortic Heart Valve Implantation (TAVI) - Clinical, patient experience, economical and occupational hazard issues
- The Palestinian perineum study
- Validation of a Continuity of Midwifery Care Model in Palestine
- About decision making processes and the organization of the vascular surgical field in the south- eastern regional health authority
- Aerial Transport of Biological material

3.5 Wireless Biomedical 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

Postdoctoral Fellows

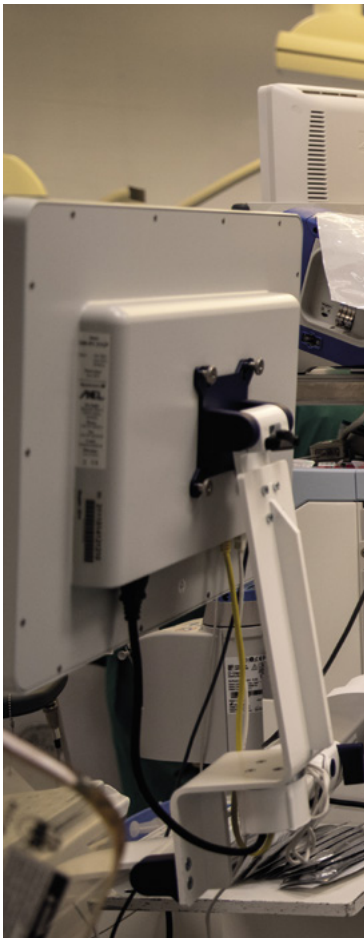
Mladen Veletic, PhD
Younghak Shin, PhD
Noha El-Ganainy

PhD candidates:

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

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. 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 Medical Robotics, visualization and navigation

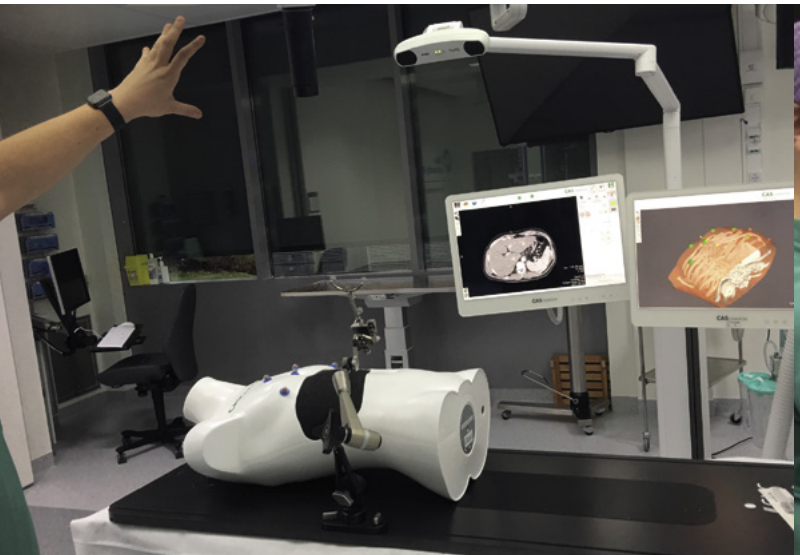
Group Leader: Professor Ole Jakob Elle, PhD

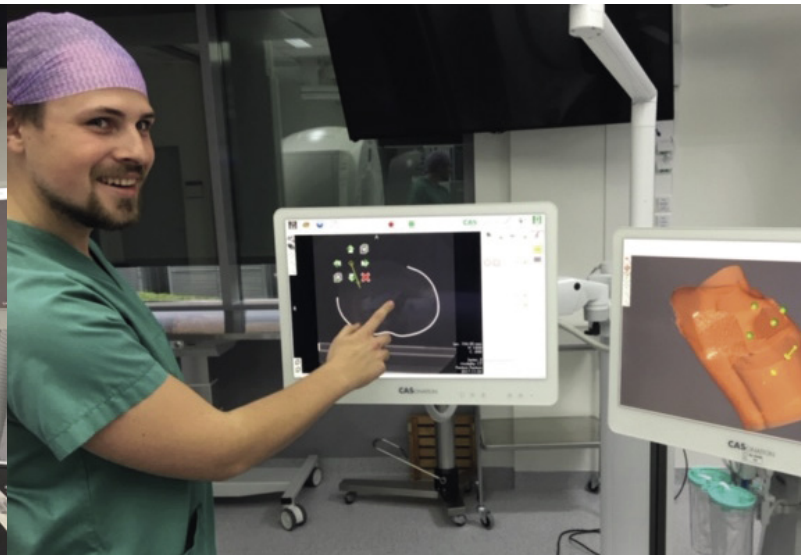
Group Members

Rafael Palomar, PhD Fellow/Software developer/Computer Graphics/Navigation
Rahul Kumar, Postdoc, Liver Image segmentation/Navigation
Louise Oram, Software developer in NorMIT.
Espen Remme, Senior Researcher in 30% (shared IVS/Kirurgisk forskning), Heart Physiology
Magnus Leon Reinsfelt Krogh, PhD Fellow, Cardiac sensor and signal processing
Ali Wajdan, PhD Fellow (PIC)
Manuel Villegas, PhD Fellow (PIC)
Robin Bugge, Image processing in 20%, MSc., 3D-print/Heart segmentation
Pravda Jith Ray, PhD Fellow, HiPerNav
Andrea Teatini, PhD Fellow, HiPerNav
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
Henrik Brun, Postdoc 50%, Pediatric Cardiologist, Planning of surgery on congenital heart diseases using
Mixed Reality Visualization and 3D printing

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 intra-operative 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 intra-operatively. 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)
- Mimiq: Tilpasningsdyktig LED sporing for navigasjon og medisinsk robotikk (Innovation)
- HoloViz and HoloNav: 3D Mixed reality Visualization of medical images in planning and treatment (Innovation)

Other ongoing projects:

- Semi-autonomous ultrasound robot for nedle insertion

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

3.7 Research Group for Industry Sponsored Studies

Group Leader: Karl Øyri, PhD

Background

In 2018 18 new project inquiries from companies were made specifically to the TestBed. 9 projects were completed in 2018, and 9 are in the pipeline. Sponsors span from small Start-Up's 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 Healthtech. 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 and 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 Bitvi.

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

3.8 BigMed

Project leader: Thomas Smedsrud, MD

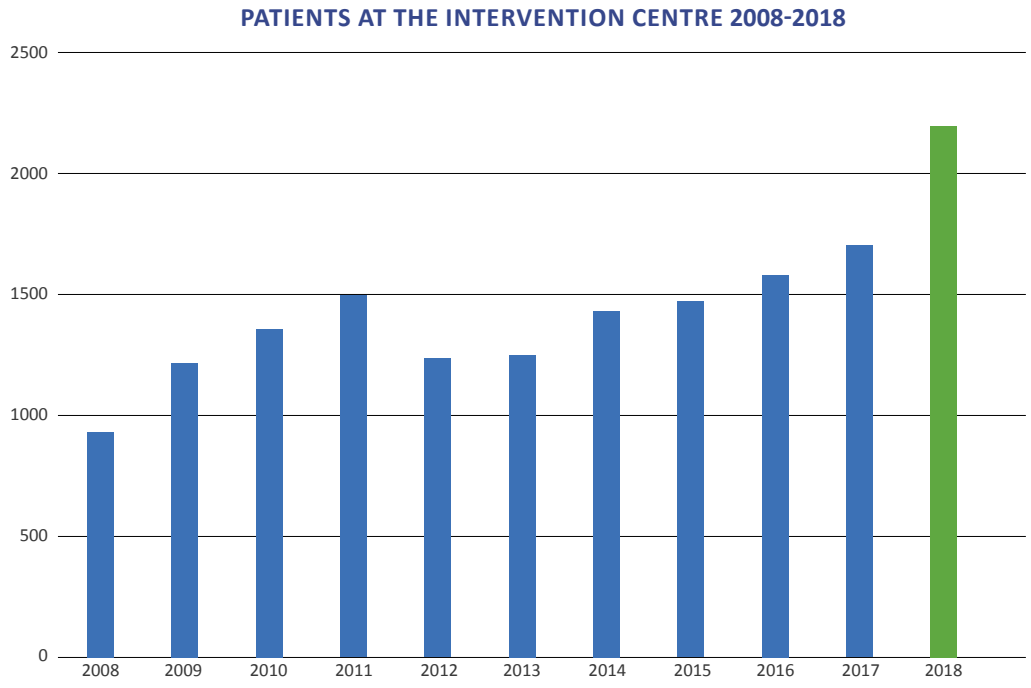
The BigMed project is an ICT Lighthouse project funded by The Research Council of Norway to promote the development of technology and services with advanced computer science on health data. The project is managed and owned by The Intervention Centre at Oslo University Hospital, and includes a broad consortium of partners from several other departments in the hospital, three faculties at the University of Oslo, industry and four patient associations. The project is laying the foundation for using big data for precision medicine, and is doing so through developing of ICT solutions for three clinical areas; rare diseases, sudden cardiac death and metastastic colorectal cancer. Examples of solutions are improved bioinformatics pipelines in both germline and somatic genome sequencing, a database for genetic variant storage, classification and sharing and a EMR dashboard solution for joint decision making in the multidisciplinary cancer teams.

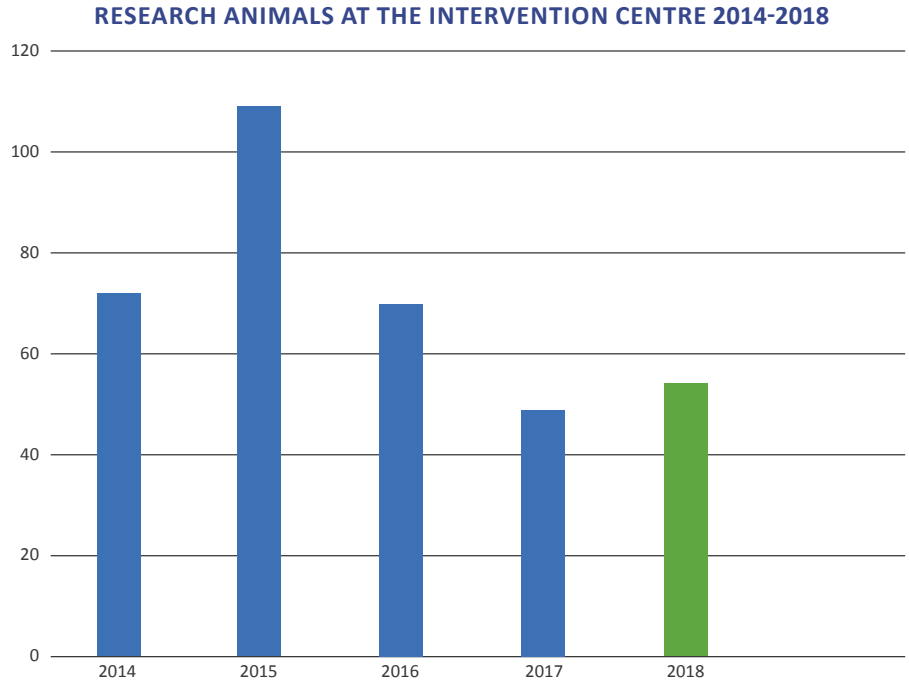
In addition to the deliveries within the clinical areas, the project has in 2018 been delivering a report on barriers towards precision medicine, started the development a big data analytics infrastructure together with OUS IKT and Sykehuspartner, and has also hosted a Nordic conference on legal issues in the field.

Website: **www.bigmed.no**

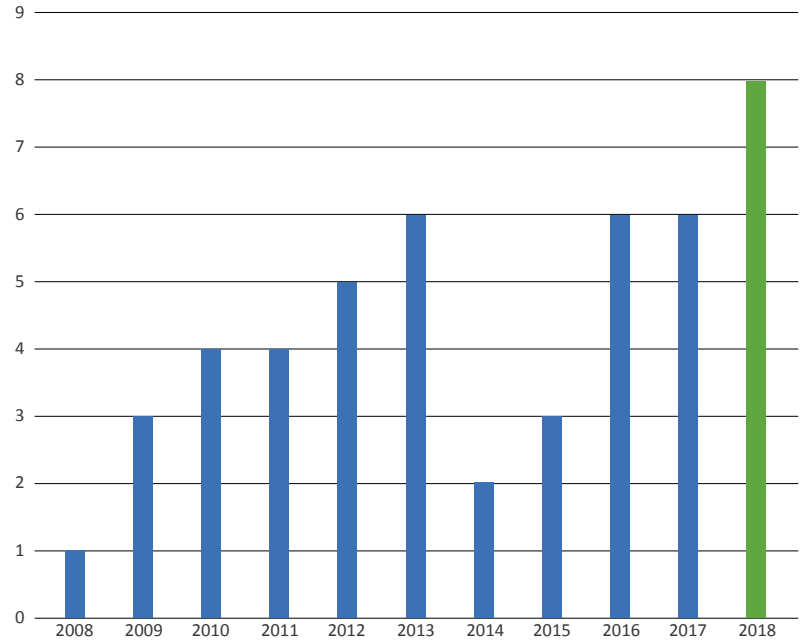
4 STATISTICS

4.1 Research activity

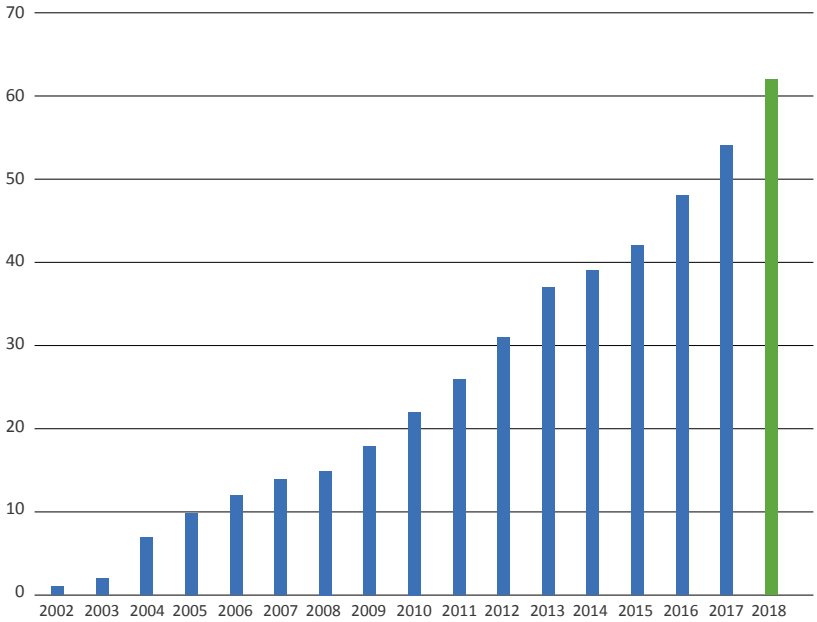




PHD´S FROM THE INTERVENTION CENTRE 2008-2018

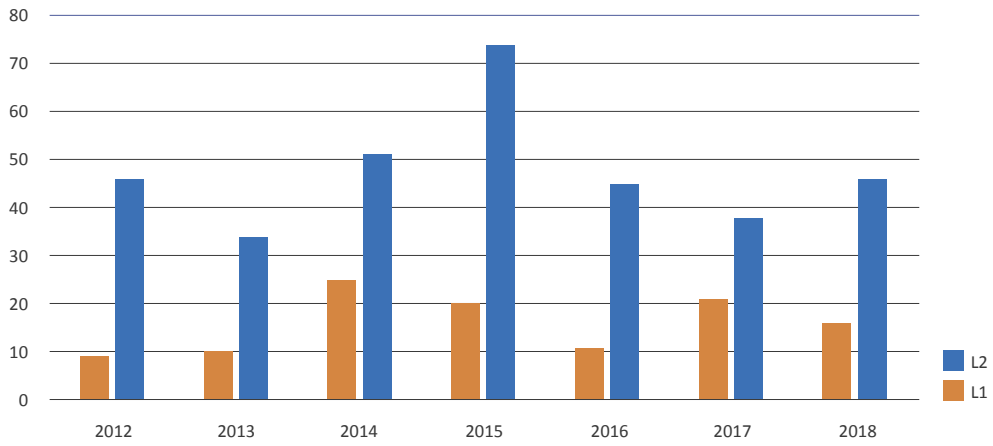


PHD´SAT THE INTERVENTION CENTRE CUMULATIVE NUMBERS



4 STATISTICS

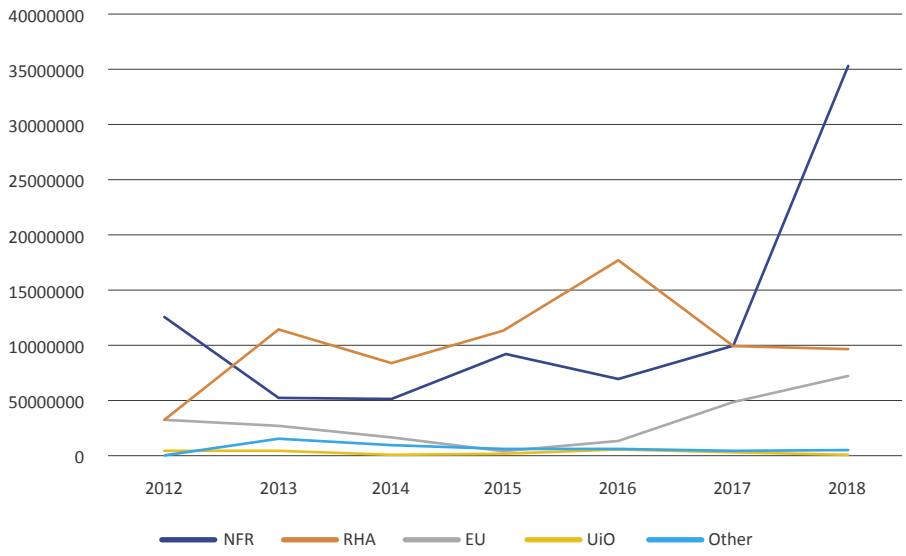
PUBLICATIONS



L1: Level 1 Publication, L2: Level 2 Publication.

The Norwegian Register for Scientific Journals, Series and Publishers is operated jointly between The National Board of Scholarly Publishing (NPU) and NSD - Norwegian Centre for Research Data on behalf of the norwegian Ministry of Education and Research. The register shows which scientific publications are recognized in the weighted funding model in Norway.

EXTERNAL RESEARCH FUNDING



NFR: Research Council of Norway, RHA: South-East Regional Health Authority, EU: European Union, UiO: University of Oslo

4.2 Financial statements

EXPENDITURES FUNDED BY HOSPITAL (NOK)

CATEGORY	BUDGET	2018
Operating expences	6 706 000	8 496 000
Payroll expences	26 078 000	25 413 000
Total	32 784 000	33 909 000

RESEARCH FUNDED EXPENDITURES (NOK)

SOURCE	2017	2018
Norwegian Research Council NFR	7 054 813	35 216 000
Regional Health Authority HSØ	17 722 553	9 619 000
European Commission EU	1 458 574	7 342 000
University of Oslo UiO	722 993	0
Norwegian Cancer Society	183 679	0
Other public foreign sources	80 797	102 000
Other public Norwegian sources	509 348	574 000
Other private Norwegian sources	38 745	0
Total	27 771 502	52 853 000

5 PUBLICATIONS

5.1 Peer reviewed scientific papers Level 2

1. *Abu Hilal M, Aldrighetti L, Dagher I, Edwin B, Troisi RI, Alikhanov R, Aroori S, Belli G, Besselink M, Briceno J, Gayet B, D'Hondt M, Lesurtel M, Menon K, Lodge P, Rotellar F, Santoyo J, Scatton O, Soubrane O, Sutcliffe R, Van Dam R, White S, Halls MC, Cipriani F, Van der Poel M et al. (2018).* The Southampton Consensus Guidelines for Laparoscopic Liver Surgery: From Indication to Implementation. Ann Surg, 268 (1), 11-18

2. *Aghayan DL, Kazaryan AM, Fretland ÅA, Sahakyan MA, Røsok BI, Bjørnbeth BA, Edwin B.* Laparoscopic liver resection for metastatic melanoma. Surg Endosc. 2018 Mar;32(3):1470-1477. Epub 2017 Sep 15.

3. *Bjørnelv GMW, Dueland S, Line PD, Joranger P, Fretland ÅA, Edwin B, Sørbye H, Aas E (2018)* Cost-effectiveness of liver transplantation in patients with colorectal metastases confined to the liver. Br J Surg, 106 (1), 132-141

4. *Brudvik KW, Jones RP, Giuliante F, Shindoh J, Passot G, Chung MH, Song J, Li L, Dagenborg VJ, Fretland ÅA, Røsok B, De Rose AM, Ardito F, Edwin B, Panettieri E, Larocca LM, Yamashita S, Conrad C, Aloia TA, Poston GJ, Bjørnbeth BA, Vauthey JN.* RAS Mutation Clinical Risk Score to Predict Survival After Resection of Colorectal Liver Metastases. Ann Surg. 2019 Jan;269(1):120-126.

5. *Cipriani F, Fantini C, Ratti F, Lauro R, Tranchart H, Halls M, Scuderi V, Barkhatov L, Edwin B, Troisi RI, Dagher I, Reggiani P, Belli G, Aldrighetti L, Abu Hilal M.* Laparoscopic liver resections for hepatocellular carcinoma. Can we extend the surgical indication in cirrhotic patients? Surg Endosc. 2018 Feb;32(2):617-626. Epub 2017 Jul 17.

6. *Dejgaard LA, Skjølsvik ET, Lie ØH, Ribe M, Stokke MK, Hegbom F, Scheirlynck ES, Gjertsen E, Andresen K, Helle-Valle TM, Hopp E, Edvardsen T, Haugaa KH (2018)* The Mitral Annulus Disjunction Arrhythmic Syndrome J Am Coll Cardiol, 72 (14), 1600-1609

7. *Francis NK, Curtis NJ, Conti JA, Foster JD, Bonjer HJ, Hanna GB; EAES committees.* EAES classification of intraoperative adverse events in laparoscopic surgery. Surg Endosc. 2018 Sep;32(9): 3822-3829. Epub 2018 Feb 12.

8. *Fretland ÅA, Dagenborg VJ, Bjørnelv GMW, Kazaryan AM, Kristiansen R, Fagerland MW, Hausken J, Tønnessen TI, Abildgaard A, Barkhatov L, Yaqub S, Røsok BI, Bjørnbeth BA, Andersen MH, Flatmark K, Aas E, Edwin B (2018).* Laparoscopic Versus Open Resection for Colorectal Liver Metastases: The OSLO-COMET Randomized Controlled Trial. Ann Surg, 267 (2), 199-207

9. *Fretland ÅA, Edwin B (2018).* Response: The OSLO-COMET Randomized Controlled Trial of Laparoscopic Versus Open Liver Resection for Colorectal Metastases. Ann Surg, 268 (6), e69-e70

10. *Halls MC, Berardi G, Cipriani F, Barkhatov L, Lainas P, Harris S, D'Hondt M, Rotellar F, Dagher I, Aldrighetti L, Troisi RI, Edwin B, Abu Hilal M (2018).* Development and validation of a difficulty score to predict intraoperative complications during laparoscopic liver resection Br J Surg, 105 (9), 1182-1191

11. *Halls MC, Cipriani F, Berardi G, Barkhatov L, Lainas P, Alzoubi M, D'Hondt M, Rotellar F, Dagher I, Aldrighetti L, Troisi RI, Edwin B, Abu Hilal M (2018).* Conversion for Unfavorable Intraoperative Events Results in Significantly Worse Outcomes During Laparoscopic Liver Resection: Lessons Learned From a Multicenter Review of 2861 Cases Ann Surg, 268 (6), 1051-1057

12. *Halls MC, Cipriani F, Berardi G, Barkhatov L, Lainas P, D'Hondt M, Rotellar F, Dagher I, Aldrighetti L, Troisi RI, Edwin B, Hilal MA (2018).* Response: "Conversion During Laparoscopic Liver Resections: a Step Forward". Ann Surg, 268 (6), e81-e82

13. *Johannessen KA, Alexandersen N (2018).* Improving accessibility for outpatients in specialist clinics: reducing long waiting times and waiting lists with a simple analytic approach BMC Health Serv Res, 18 (1), 827

14. *Nesgaard JM, Stimec BV, Soulie P, Edwin B, Bakka A, Ignjatovic D (2018).* Defining minimal clearances for adequate lymphatic resection relevant to right colectomy for cancer: a post-mortem study. Surg Endosc, 32 (9), 3806-3812

15. *Fouladi SH, Chiu S-E, Rao B, Balasingham I.* Recovery of Independent Sparse Sources From Linear Mixtures Using Sparse Bayesian Learning. IEEE Transactions on Signal Processing. 2018;66(24):6332-46.

16. *Chelli A, Zedini E, Alouini M-S, Pätzold MU, Balasingham I.* Throughput and delay analysis of HARQ with code combining over double Rayleigh fading channels. IEEE Transactions on Vehicular Technology. 2018;67(5):4233-47.

5.2 Peer reviewed scientific papers Level 1

1. *Albatat M, King DR, Unger LA, Arevalo H, Wall S, Sundnes J, Bergsland J, Balasingham I (2018)* Electromechanical Model to Predict Cardiac Resynchronization Therapy Conf Proc IEEE Eng Med Biol Soc, 2018, 5446-5459

2. *Ali-Masri H, Hassan S, Fosse E, Zimmo KM, Zimmo M, Ismail KMK, Vikanes Å, Laine K (2018)* Impact of electronic and blended learning programs for manual perineal support on incidence of obstetric anal sphincter injuries: a prospective interventional study BMC Med Educ, 18 (1), 258

3. *Ali-Masri H, Hassan S, Ismail K, Zimmo K, Zimmo M, Fosse E, Vikanes Å, Laine K (2018)* Enhancing recognition of obstetric anal sphincter injuries in

six maternity units in Palestine: an interventional quality improvement study
BMJ Open, 8 (6), e020983

4. *Ali-Masri HY, Hassan SJ, Zimmo KM, Zimmo MW, Ismail KMK, Fosse E, Alsalman H, Vikanes Å, Laine K (2018)*
Evaluation of Accuracy of Episiotomy Incision in a Governmental Maternity Unit in Palestine: An Observational Study
Obstet Gynecol Int, 2018, 6345497

5. *Andresen B, Døhlen G, Diep LM, Lindberg H, Fosse E, Andersen MH (2018)*
Psychosocial and clinical outcomes of percutaneous versus surgical pulmonary valve implantation
Open Heart, 5 (1), e000758

6. *Bergan HA, Halvorsen PS, Espinoza A, Kerans V, Skulstad H, Fosse E, Bugge JF (2018)*
Left Ventricle Function During Therapeutic Hypothermia with Beta1-Adrenergic Receptor Blockade
Ther Hypothermia Temp Manag, 8 (3), 156-164

7. *Bose P, Khaleghi A, Albatat M, Bergsland J, Balasingham I (2018)*
RF Channel Modeling for Implant-to-Implant Communication and Implant to Subcutaneous Implant Communication for Future Leadless Cardiac Pacemakers
IEEE Trans Biomed Eng, 65 (12), 2798-2807

8. *Bose P, Khaleghi A, Balasingham I (2018)*
In-Body and Off-Body Channel Modeling for Future Leadless Cardiac Pacemakers Based on Phantom and Animal Experiments
IEEE Antennas Wirel. Propag. Lett., 17 (12), 2484-2488

9. *Bose P, Khaleghi A, Balasingham I (2018)*
Wireless Channel Modeling for Leadless Cardiac Pacemaker: Effects ofVentricular Blood Volume
Conf Proc IEEE Eng Med Biol Soc, 2018, 3746-3749

10. *Brudvik KW, Røsok B, Naresh U, Yaqub S, Fretland ÅA, Labori KJ, Edwin B, Bjørnbeth BA (2018)*
Survival after resection of colorectal liver metastases in octogenarians and sexagenarians compared to their respective age-matched national population
Hepatobiliary Surg Nutr, 7 (4), 234-241

11. *Buanes T, Edwin B.* Long term oncological outcome of laparoscopic techniques in pancreatic cancer.
World J Gastrointest Endosc. 2018 Dec 16;10(12):383-391. Review.

12. *Bugge JF, Kerans V, Nyrerød HC, Halvorsen PS (2018)*
Haemodynamic evaluation and optimisation of brain-dead donors with oesophageal Doppler during organ harvesting: A feasibility study
Eur J Anaesthesiol, 35 (11), 893-895

13. *Bøgseth AØ, Soares JZ, Undseth R, Valeur J (2018)*
Artery of Percheron occlusion
Tidsskr Nor Laegeforen, 138 (19)

14. *Eide PK, Vatnehol SAS, Emblem KE, Ringstad G (2018)*
Magnetic resonance imaging provides evidence of glymphatic drainage from human brain to cervical lymph nodes
Sci Rep, 8 (1), 7194

15. *Fossum S, Halvorsen S, Vikanes ÅV, Roseboom TJ, Ariansen I, Næss Ø (2018)*
Cardiovascular risk profile at the age of 40-45 in women with previous hyperemesis gravidarum or hypertensive disorders in pregnancy: A population-based study
Pregnancy Hypertens, 12, 129-135

16. *Fouladi SH, Balasingham I, Kansanen K, Ramstad TA (2018)*
Blind Source Separation Using Temporal Correlation, Non-Gaussianity and Conditional Heteroscedasticity
IEEE Access, 6, 25336-25350

17. *Gaupset R, Nesgaard JM, Kazaryan AM, Stimec BV, Edwin B, Ignjatovic D (2018)*
Introducing Anatomically Correct CT-Guided Laparoscopic Right Colectomy with D3 Anterior Posterior Extended Mesenterectomy: Initial Experience and Technical Pitfalls
J Laparoendosc Adv Surg Tech A, 28 (10), 1174-1182

18. *Godt JC, Eken T, Schulz A, Johansen CK, Aarsnes A, Dormagen JB (2018)*
Triple-split-bolus versus single-bolus CT in abdominal trauma patients: a comparative study
Acta Radiol, 59 (9), 1038-1044

19. *Halls MC, Cherqui D, Taylor MA, Primrose JN, Abu Hilal M;* Collaborators of The Difficulty of Laparoscopic Liver Surgery Survey. Are the current difficulty scores for laparoscopic liver surgery telling the whole story? An international survey and recommendations for the future. HPB (Oxford). 2018 Mar;20(3):231-236. Epub 2017 Sep 29.

20. *Kalheim LF, Fladby T, Coello C, Bjørnerud A, Selnes P (2018)*
[18F]-Flutemetamol Uptake in Cortex and White Matter: Comparison with Cerebrospinal Fluid Biomarkers and [18F]-Fludeoxyglucose
J Alzheimers Dis, 62 (4), 1595-1607

21. *Kleive D, Sahakyan MA, Khan A, Fosby B, Line PD, Labori KJ (2018)*
Incidence and management of arterial injuries during pancreatectomy
Langenbecks Arch Surg, 403 (3), 341-348

22. *Kristiansen S, Goebel V, Oyri K, Plagemann T (2018)*
Event-Based Methodology for Real-Time Data Analysis in Cyber Physical Systems
ADV INTELL SYST, 661, 184-195

5 PUBLICATIONS

23. *Kumar RP, Barkhatov L, Edwin B, Albregtsen F, Elle OJ (2018)*
Portal and Hepatic Vein Segmentation with Leak Restriction: A Pilot Study
IFMBE PROC, 65, 823-826

24. *Mortensen B, Lukasse M, Diep LM, Lieng M, Abu-Awad A, Suleiman M, Fosse E (2018)*
Can a midwife-led continuity model improve maternal services in a low-resource setting? A non-randomised cluster intervention study in Palestine
BMJ Open, 8 (3), e019568

25. *Palomar R, Gomez-Luna J, Cheikh FA, Olivares-Bueno J, Elle OJ (2018)*
High-Performance Computation of Bezier Surfaces on Parallel and Heterogeneous Platforms
Int. J. Parallel Program., 46 (6), 1035-1062

26. *Pérez de Frutos J, Hofstad EF, Solberg OV, Tangen GA, Lindseth F, Langø T, Elle OJ, Mårvik R (2018)*
Laboratory test of Single Landmark registration method for ultrasound-based navigation in laparoscopy using an open-source platform
Int J Comput Assist Radiol Surg, 13 (12), 1927-1936

27. *Ringstad G, Valnes LM, Dale AM, Pripp AH, Vatnehol SS, Emblem KE, Mardal KA, Eide PK (2018)*
Brain-wide glymphatic enhancement and clearance in humans assessed with MRI
JCI Insight, 3 (13), e121537

28. *Sahakyan MA, Kleive D, Kazaryan AM, Aghayan DL, Ignjatovic D, Labori KJ, Røsok BI, Edwin B (2018)*
Extended laparoscopic distal pancreatectomy for adenocarcinoma in the body and tail of the pancreas: a single-center experience
Langenbecks Arch Surg 2018 Dec;403(8):941-948. Epub 2018 Nov 11.

29. *Sahakyan MA, Røsok BI, Kleive D, Fretland ÅA, Kazaryan AM, Labori KJ, Edwin B.*
The European Experience in Laparoscopic Pancreatic Resections.
J Am Coll Surg. 2018 Jan;226(1):104.

30. *Sallinen VJ, Le Large TYS, Tieftrunk E, Galeev S, Kovalenko Z, Haugvik SP, Antila A, Franklin O, Martinez-Moneo E, Robinson SM, Panzuto F, Regenet N, Muffatti F, Partelli S, Wiese D, Ruszniewski P, Dousset B, Edwin B, Bartsch DK, Sauvanet A, Falconi M, Ceyhan GO, Gaujoux S;* Pancreas 2000 research group. Prognosis of sporadic resected small (≤2 cm) nonfunctional pancreatic neuroendocrine tumors - a multi-institutional study. HPB (Oxford). 2018 Mar;20(3): 251-259. Epub 2017 Oct 5.

31. *Schalit I, Espinoza A, Pettersen FJ, Thiara APS, Karlsen H, Sørensen G, Fosse E, Fiane AE, Halvorsen PS (2018)*
Accelerometer Detects Pump Thrombosis and Thromboembolic Events in an In vitro HVAD Circuit
ASAIO J, 64 (5), 601-609

32. *Shin Y, Balasingham I (2018)*
Automatic polyp frame screening using patch based combined feature and dictionary learning
Comput Med Imaging Graph, 69, 33-42

33. *Shin Y, Qadir HA, Balasingham I (2018)*
Abnormal Colon Polyp Image Synthesis Using Conditional Adversarial Networks for Improved Detection Performance
IEEE Access, 6, 56007-56017

34. *Shin Y, Qadir HA, Aabakken L, Bergsland J, Balasingham I (2018)*
Automatic Colon Polyp Detection Using Region Based Deep CNN and Post Learning Approaches
IEEE Access, 6, 40950-40962

35. *Strand-Amundsen RJ, Reims HM, Reinholt FP, Ruud TE, Yang R, Høgetveit JO, Tønnessen TI (2018)*
Ischemia/reperfusion injury in porcine intestine - Viability assessment
World J Gastroenterol, 24 (18), 2009-2023

36. *Strand-Amundsen RJ, Tronstad C, Kalvøy H, Ruud TE, Høgetveit JO, Martinsen ØG, Tønnessen TI (2018)*
Small intestinal ischemia and reperfusion-bioimpedance measurements
Physiol Meas, 39 (2), 025001

37. *Strand-Amundsen RJ, Tronstad C, Reims HM, Reinholt FP, Høgetveit JO, Tønnessen TI (2018)*
Machine learning for intraoperative prediction of viability in ischemic small intestine
Physiol Meas, 39 (10), 105011

38. *Teatini A, Pérez Frutos de J, Langø T, Edwin B, Elle O*
Assessment and comparison of target registration accuracy in surgical instrument tracking technologies.
Conf Proc IEEE Eng Med Biol Soc. 2018 Jul;2018:1845-1848.

39. *Wang C, Alaya Cheikh F, Kaaniche M, Beghdadi A, Elle OJ (2018)*
Variational based smoke removal in laparoscopic images
Biomed Eng Online, 17 (1), 139

40. *Wang CC, Cheikh FA, Kaaniche M, Elle OJ (2018)*
Liver surface reconstruction for image guided surgery
PRO BIOMED OPT IMAG, 10576, UNSP 105762H

41. *Wang JQ, Nomura K, Narita H, Ito F, Anzai D, Bergsland J, Balasingham I (2018)*
Development and In Vivo Performance Evaluation of 10-60-MHz Band Impulse-Radio-Based Transceiver for Deep Implantation Having 10 Mb/s
IEEE Trans. Microw. Theory Tech., 66 (9), 4252-4260

42. *Zimmo K, Laine K, Fosse E, Zimmo M, Ali-Masri H, Zucknick M, Vikanes Å, Hassan S (2018)*
Episiotomy practice in six Palestinian hospitals: a population-based cohort study among singleton vaginal births
BMJ Open, 8 (7), e021629
DOI 10.1007/s00192-018-3711-6, PubMed 30008080 Cristin 1620228 (Details)

43. *Zimmo M, Laine K, Hassan S, Fosse E, Lieng M, Ali-Masri H, Zimmo K, Anti M, Bottcher B, Sørum Falk R, Vikanes Å (2018)*
Differences in rates and odds for emergency caesarean section in six Palestinian hospitals: a population-based birth cohort study
BMJ Open, 8 (3), e019509

44. *Zimmo MW, Laine K, Hassan S, Bottcher B, Fosse E, Ali-Masri H, Zimmo K, Sørum Falk R, Lieng M, Vikanes Å (2018)*
Caesarean section in Palestine using the Robson Ten Group Classification System: a population-based birth cohort study
BMJ Open, 8 (10), e022875

45. *Aarsnes A, Dahle G, Fosse E, Rein KA, Aaberge L, Martinsen ACT (2018)*
EVALUATION OF OCCUPATIONAL RADIATION DOSE IN TRANSCATHETER AORTIC VALVE IMPLANTATION
Radiat Prot Dosimetry, 179 (1), 9-17

5.3 PhD Theses 2018

1. *Palomar R.* Geometric Modeling for Planning of liver resection procedures. NTNU; 2018.

2. *Larsson C.* Prognostic value of optimized dynamic contrast-enhanced magnetic resonance imaging of High-grade gliomas. Faculty of Mathematics and Natural Sciences, University of Oslo; 2018.

3. *Bergan H.* Cardiac effects of ECMO cardiopulmonary resuscitation and beta1- adrenergic receptor blockade during hypothermia, Faculty of Medicine, University of Oslo; 2018.

4. *Fouladi SH.* On Signal Recovery: Independent Component Analysis for Multiple Measurement Vectors and Source Separation. NTNU; 2018.

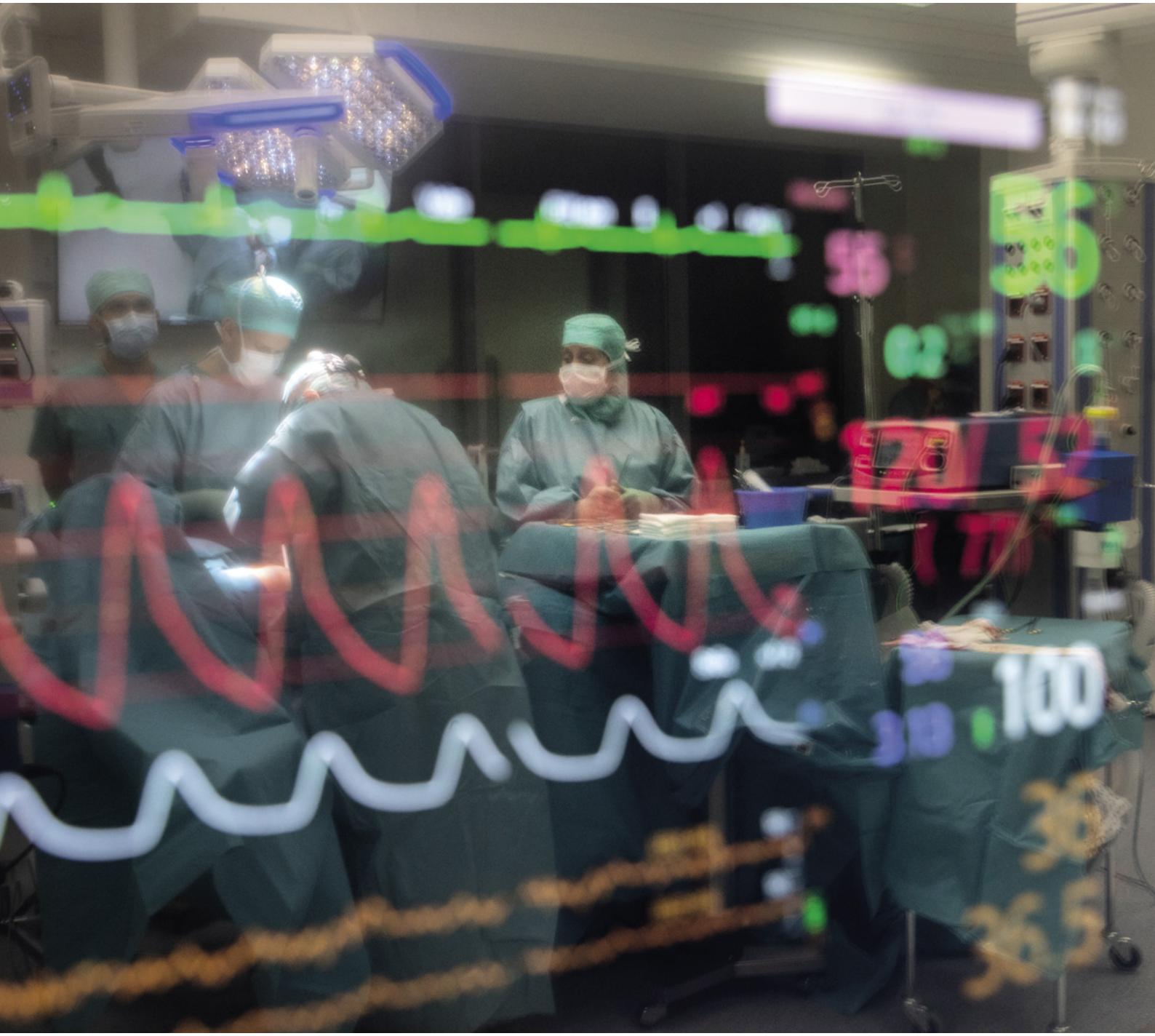
5. *Zimmo M.* Exploring caesarean section in Palestine. Faculty of Medicine, University of Oslo; 2018.

6. *Zimmo K.* Episiotomy practice in Palestine. Rates, indications and impact of an educational program in six hospitals. Faculty of Medicine, University of Oslo; 2018.

7. *Ali H.* Palestinian perineum study. Obstetric anal sphinkter injuries in Palestine: education and training in detection and prevention. Faculty of Medicine, University of Oslo; 2018.

8. *Andresen B.* Percutaneous pulmonary valve implantation impact on clinical outcome, patients self-reported health, psychosocial function, and hospital costs in patients with congenital heart disease. Faculty of Medicine, University of Oslo; 2018.

Oslo University Hospital



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ANNUAL REPORT 2018

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