Annual report 2021
Operating Room of the Future

St. Olavs hospital FOR – NorMIT Infrastructure

Operating Room of the Future

ST. OLAVS HOSPITAL
TRONDHEIM UNIVERSITY HOSPITAL

NTNU

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UNIVERSITETSSYKEHUSET I TRONDHEIM

NTNU | Norwegian University of Science and Technology

Frontpage photo: St. Olavs Hospital

Preface

The year 2021 was also a special year, still marked by the pandemic in various ways.

"Operating Room of the Future" (FOR) has maintained all its activity during the period.

During the year, we have followed up and arranged for PhD scholars, master's students and bachelor's students who all carried out their assignments using FOR infrastructure.

Several different research-initiated or industry-initiated projects were also carried out during the year.

During 2021, under the auspices of Helse Midt-Norge, several project meetings have been held with regard to the preparation and establishment of NorTrials - New partnership for research on patient care.

Clinical studies are central to the development of new medicines and medical equipment. It gives patients access to new forms of treatment, it gives practitioners and researchers new knowledge, and it gives the pharmaceutical industry the opportunity to test the effect of medicines and equipment. NorTrial's center for medical equipment is planned to be added to St. Olavs Hospital, the Research Department at FOR.

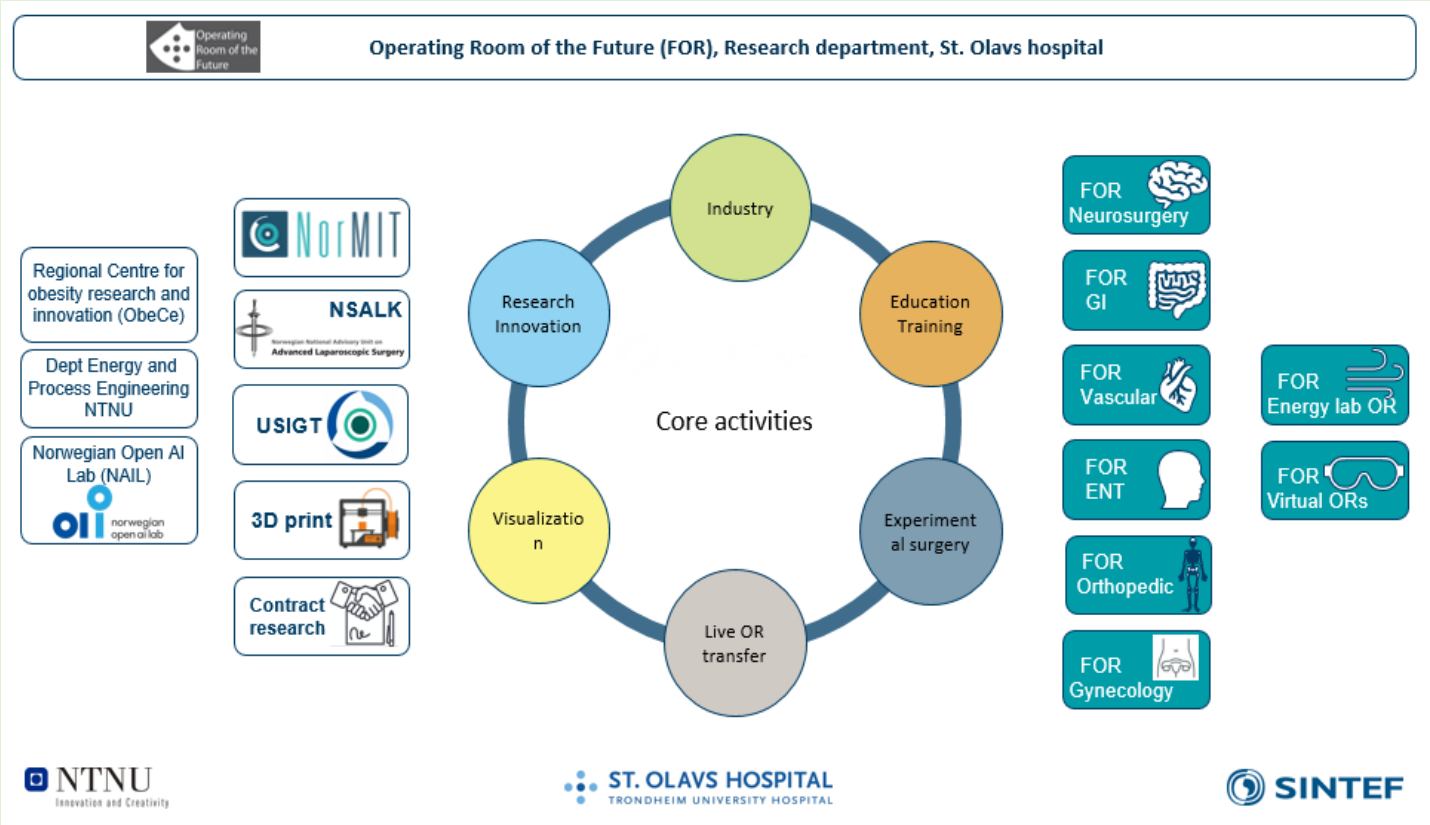
As a result of the pandemic, most course activities, lectures and participation in conferences were cancelled. Much of the meeting activity took place on digital platforms.

In this edition of the annual report, we will show what FOR and NorMIT's infrastructure consists of and at the same time give you an insight into our activity during 2021.

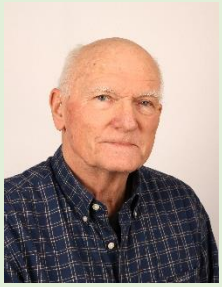
We wish you a good reading of our annual report for 2021!

Jan Gunnar Skogås
Head of department
Managing director
Photo: St. Olavs Hospital

Organization of the Operating Room of the Future



Staff



Hans Olav Myhre
Emeritus professor
of surgery

Jan Gunnar Skogås
Managing Director

Ivar Rossvoll
Associate Professor

Ronald Mårvik
Associate Professor

Frode Manstad-Hulaas
Associate Professor

Liv-Inger Stenstad
R&D coordinator

Jan- Magne Gjerde
R&D coordinator

Gabriel Kiss
Scientist, R&D coordinator

Ingrid Granbo
R&D coordinator

Marianne Haugvold
Advisor R&D

Vigdis Schnell Husby
R&D coordinator

Guangyu Cao
Professor NTNU

Thomas Langø
Chief Scientist

Gunnar Gjeldnes
R&D coordinator

Maria Erlandsen Lynghaug
Economic adviser

Trine Selbekk Øvstebø
Economic adviser

Sara Edvardsen
Scientist, R&D
coordinator

Photo: St. Olavs Hospital

Scientific advisory board

An important task for FOR is to improve the quality and quantity of clinical research. Therefore the scientific advisory board is going through all research protocols, giving advice to those who are doing projects under the direction of FOR. FOR has special guidelines for projects, including the tasks of the scientific advisory board as well as a description how to make research protocols (Professor Per Farup). These documents are forming the basis for the collaboration between FOR and those who are conducting research projects there. In addition we are making separate agreements between FOR and the project leaders.
FOR additionally contributes a great deal to students at the research line at The faculty of Medicine (NTNU), an offer for medical students who are interested in research and a possible future research career possibly parallel to clinical activities.

The scientific advisory board has the following members:

Associate Professor Ivar Rossvoll (leader)

Emeritus professor Hans Olav Myhre

Professor Per Farup

Professor Olav Haraldseth

Professor Ståle Nordgård

Associate Professor Frode Manstad-Hulaas

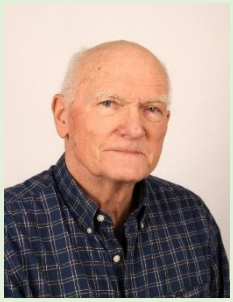
Associate Professor Knut Haakon Stensæth

Research director Thomas Langø

Associate Professor Wenche Moe Thorstensen

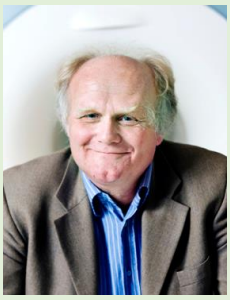
Specialist in clinical pharmacy Trond Oskar Aamo

Ivar Rossvoll
Scientific adviser
Associate professor



Hans Olav Myhre
Emeritus professor
in surgery

Per G. Farup
Professor



Olav Haraldseth
Professor

Wenche Moe
Thorstensen
Associate Professor

Ståle Nordgård
Professor

Frode Manstad-Hulaas
Associate Professor

Knut Haakon Stensæt
Assistant professor

Thomas Langø
Chief Scientist

Trond Oskar Aamo
Specialist in clinical
pharmacology

Photos: St. Olavs Hospital, NTNU, SINTEF and private

Highlights of 2021

Trine Selbekk Øvstebø was appointed as an economic advisor in FOR. Trine previously has a Bachelor in Economics and Administration - with a specialization in financial management. She has solid experience as a project controller, as well as in invoicing and follow-up of customer receivables, closing accounts and assisting project managers and management with financial follow-up. In FOR, Trine will mainly work with finance associated with FOR Research and Contracts.

We welcome Trine to FOR and good luck with new challenges!

Trine Selbekk Øvstebø
Photo: St. Olavs Hospital

Sara Edvardsen was hired as a Research Scientist at the Operating Room of the Future. She is an engineer with a master's degree in Electronic System Design & Innovation, and has a specialisation in Nanoelectronics and Photonics. Through the years she has developed a huge passion for medical technology. Due to this passion, she went abroad to Scotland for a year, to study Biomedical Engineering. This background gives her a solid competence in the application of electronics, photonics and robotics in diagnostics, surgery and therapy. We consider her to be a proficient team member in research and development of medical technology.

The fields of Electronics and Photonics Sara finds most exciting when used to monitor and determine the status of the human body. She believes that using technology for the purpose of helping people is incredibly rewarding and motivating. Therefore, the interface between technology and anatomy is where Sara thrives the most. Her interests include for example optic sensors.

We are happy to announce that Sara has become a part of our team. We wish her a warm welcome, and lots of luck with new challenges!

Sara Edvardsen
Photo: St. Olavs Hospital

Defence of Thesis 22nd April: Jakub Wladyslaw Dziedzic – Faculty of Engineering

Jakub Wladyslaw Dziedzic has submitted the following academic thesis as a part of the doctoral work at the Norwegian University of Science and Technology (NTNU), Department of Energy and Process Engineering:

«A novel monitoring and modeling technique for energy-related occupant behaviour»

The Faculty has appointed the following Assessment Committee to assess the thesis:

- Assistant Professor Pieter-Jan Hoes, Eindhoven University of Technology, The Netherlands
- Professor Bjørn Reidar Sørensen, UiT The Arctic University of Norway
- Professor Hans Martin Mathisen, NTNU

Professor Vojislav Novakovic, Department of Energy and Process Engineering, has been the candidate's main supervisor. Professor Da Yan, Tsinghua University and Associate Professor Laurent Francis Ghisl Georges, Department of Energy and Process Engineering, have been the candidate's co-supervisors.

As a PhD Candidate of the Department of Energy and Process Engineering, I have developed a methodology to motion capture occupant indoor activities. The development scope was to track energy-related activities, but due to robustness of the proposed method, it was possible to implement it in different fields of research.We have managed to conduct series of experiments in surgical rooms with mixed and laminar ventilation. The goal of the research was to investigate the influence of surgeons and nurses on a spread of bacterial contamination. Conducting this investigation required usage of the motion capture technique and passive CFU sampling. The developed methodology was responsible for capturing the surgical staff spatial displacement and their activity. The preliminary results of research have highlighted critical issues influencing the contamination rate of surgical rooms with mixed ventilation.

Jakub Wladyslax Dziedzic
Photo: NTNU

Activity at the FOR Operating Rooms

Surgical Clinic

Operative activity FOR operating room AH- 1F Department of Surgery 2021	
TAVI	85
EVAR	103
Various vascular operations	28
Thoraco-abdominal stent-grafts w/ side branches	11
Combined procedures (open operation +PTA/stent)	57
Various endovascular procedures (coiling etc.)	17
Removal of infected pacemaker wires	7
Total	**308**

Torbjørn Dahl
Head of Surgical Clinic
Photo: St. Olavs Hospital

Operative activity, FOR operating room 4 Department of surgery 2021	
Upper gastro	44
Middle gastro	117
Lower gastro	247
Total	**408**

Department of Radiology and Nuclear Medicine

Edmund Søvik
Chief Attending Physician
Clinic for Medical Imaging
Photo: St. Olavs Hospital

Activity that the Clinic for Medical Imaging has participated in at the FOR operating room at AHL 2021	
Stent grafts in the abdominal aorta	75
Stent grafts in the thoracic aorta	28
Thoraco-abdominal stent-grafts w/ side branches	11
Combined intervention in the pelvis and lower extremities	57
Other	45
Total	**216**

Department of Women`s Diseases

Tone Shetelig Løvvik
Head of Clinic of Women's diseases
Photo: St. Olavs Hospital

Operative activity FOR operating room 7 Department of Women and Children's diseases 2021	
Maternity unit	40
Gyn Cancer	1
Gyn General	22
Total	**63**

Department of Neurosurgery

Tomm Brostrup Müller
Head of the Department of Neurosurgery
Photo: Aleris

Operative activity at FOR operating room 3 Department of Neurosurgery 2021	
Craniotomies/intracranial operations, vascular lesions and head trauma	146
Shunt operations	20
Operations on the spinal canal, spinal cord	110
Other operations: • Nerve root • Pain or dysfunksjon	29
Total	**305**

Clinic for Orthopedic-, Rheumatology and Skin Diseases

Vigleik Jessen
Head of Clinic for Orthopedic,
Rheumatologic and Skin Diseases
Photo: St. Olavs Hospital

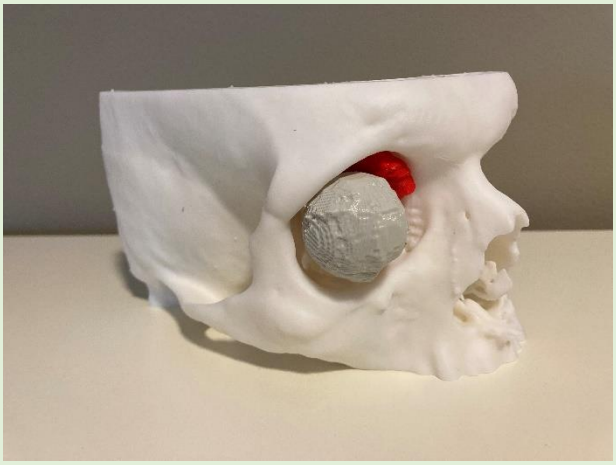
Operative activity FOR operating room 8 Clinic of Orthopedic Surgery 2021	
Hip prostheses	125
Knee prostheses	243
Other operations	47
Total	**415**

Clinic of Ear-Nose-Throat, Eye- and Maxillofacial Surgery

Marit Fagerli
Head of Clinic
Department of ENT, Maxillofacial and Eye diseases
Photo: Privat

Operative activity at the FOR operating room 1 Department of ENT, Maxillofacial and Eye diseases in 2021	
Various ear surgery	213
Various maxillofacial surgery	534
Total	**747**

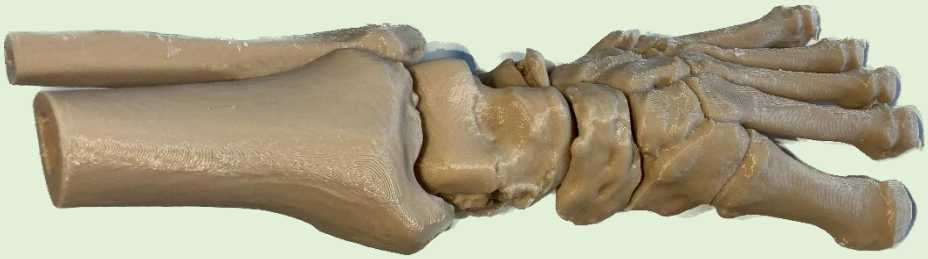
FOR – NorMIT 3D-printlab



Providing more patient specific treatment through virtual planning and 3D-printing is increasing in popularity both nationally and internationally, as the benefits for the patient and surgeon becomes more evident. St Olavs Hospital has since 2018 had its own centralized 3D-print-lab, and the volume of cases has been rising exponentially.

More than half of the cases in 2021 came from the cranio-maxillofacial department who use virtual planning and 3D-printing as standard tools for orthognathic surgery, temporomandibular joint replacements, and mandibular reconstructions, in addition to anatomical models for better understanding other complex cases.

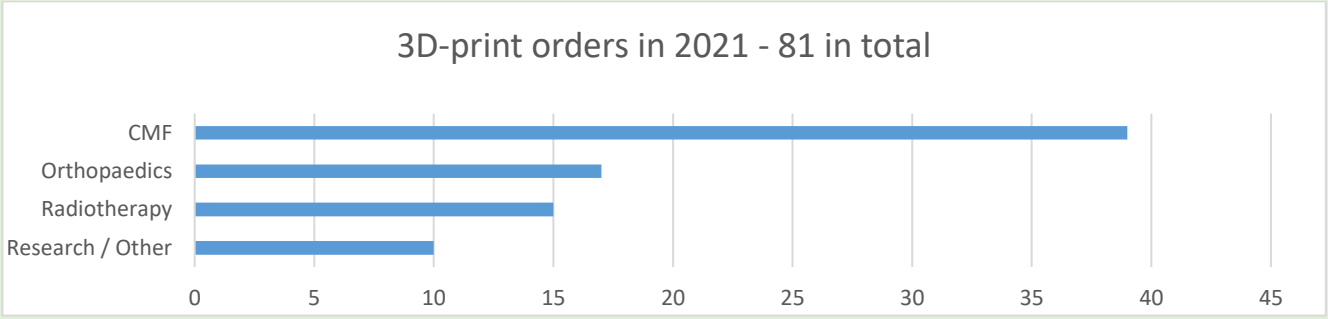
The orthopedic department is also increasing its use of physical 3D-printed anatomical models for surgical planning and pre-operative preparation of osteosynthesis equipment. The use of patient-specific surgical guides to ensure accurate deployment of the pre-operative plan is also increasing.



The lab also provide patients specific boluses for radiotherapy treatment in the face region.

In addition to these clinical applications, the lab also provide equipment and prototypes to researchers at the hospital and university.

Along with OUS, SINTEF and numerous international hospitals/universities and research institutions, St Olavs 3D-print-lab is also a partner in MIREIA (Mixed Reality in medical Education based on Interactive Applications). This EU-funded research project will look at the use of cutting-edge technology in immersive virtual technology and 3D-printing with personalized learning content to promote the student-centered learning process of medical students and residents.



Activity at St. Olavs Hospital FOR - Research and Contracts

St. Olavs Hospital FOR Research and Contracts is managing externally financed clinical trials at St. Olavs Hospital, Levanger Hospital and Namsos Hospital. On behalf of these hospitals, we are responsible for study contracts and budgeting, as well as the financial control from the start until completion of the study.
St. Olavs hospital FOR Research and Contracts handle:
- Contract and financial negotiations with the company, based on the study protocol and associated resource requirements for implementation of the study
- Contact with the various service departments, such as laboratory and radiology service, collecting price estimates and setting up the study budget
- Finalizing and signing of main contract together with the external company
- Sub-contracts with internal departments at the hospital
- Financial control and follow-up during the study; including invoicing, project accounting and reporting
- Filing essential documents for completed studies (15 years according to GCP)

In 2021, **17 new studies were registered** - of which **14 are industry sponsored studies** (the Clinical study is initiated by an external party covering all study costs) and **3 are partly fundes studies**. Partly fundes studies are investigator initiated clinical studies which receive financial contribution covering parts of the study costs. The investigator/hospital is the sponsor (responsible for the study and owner of the data). St. Olavs hospital FOR Research and Contracts has a portfolio and administers approximately 90 active studies at any time.

In 2021 Trine Selbekk Øvstebø was employed as a financial advisor at St. Olavs Hospital FOR Research and Contracts. Trine previously has a Bachelor in Economics and Administration - specializing in financial management. She has solid experience as a project controller, as well as in invoicing and follow-up of accounts receivable, closing accounts and assisting project managers and management with financial follow-up.

FOR-NorMIT infrastructure

In 2021, the NorMIT infrastructure was used to a large extent by 121 users in Trondheim and Oslo, with 43 different projects benefiting from the NorMIT infrastructure. In Trondheim, 1 PhD is completed and 6 PhDs are in progress. 2 Master's candidates and 6 Bachelor students were involved in research collaboration with FOR-NorMIT. A total of 13 articles, 4 national presentations and 2 international presentations were based on NorMIT-related work.

Users of the infrastructure	**2021**
Total number of users	121
Total number of internal users (Users employed by the host institutions	22
Total number of external users (Users not employed by the host institutions	9
Number of students (Master, Bachelor)	8
Number of PhD students	22
Number of scientists (permanent employment, post doc etc.)	4
Number of users from industry	15
Type of projects (funding) where the infrastructure has been used	**2021**
Total number of projects	43
Number of projects with international funding (EU, Nordic, etc.)	1
Number of projects with external national funding	3
Number of projects funded by the host institution (e.g. via the basic budget)	24
Number of projects funded by the industry	15

An overview of all equipment that can be ordered from FOR-NorMIT is available at www.normit.no

Our partners have used NorMIT equipment park extensively

Department of Circulation and Imaging (ISB)

The ultrasound laboratory at NTNU, Department of Circulation and Medical Imaging hosts two Verasonics Vantage systems which are used in various projects related to cardiovascular imaging, contrast agent development and imaging, and for the development and use of dual-frequency ultrasound transducers, used for instance to enhance image quality and cancer treatment. The laboratory also hosts the Onda Acoustic Intensity Measurement System (AIMS III) which is used for determining acoustic safety in clinical trials using both NorMIT Verasonics systems and research scanners owned by the laboratory.

At ISB we use these systems to develop high frame rate imaging applications, such as vector-Doppler imaging which may shed new light on the development of plaques in the carotid artery, as well as new high frame rate cardiac imaging setups to improve quantification of cardiac function. These efforts use extensive imaging setup enabled by the powerful Verasonics systems in NorMIT and has resulted in several fruitful international collaborations.

Another project connected to Center for Innovative Ultrasound Solutions (CIUS) focuses on optimizing the performance of Doppler ultrasound using single element transducers for flow estimation through cracks/fissures and resulted in 1 journal paper in 2021.

In a project funded by The Liaison Committee for Education, Research and Innovation in Central Norway, SINTEF is working in collaboration with ISB and pulmonologists at St. Olavs Hospital and Levanger Hospital to improve characterization of mediastinal lymph nodes in lung cancer patients. The Verasonics Vantage system is used for implementation of shear wave imaging applications with clinical linear transducers. Implementation for nonlinear tissue characterization with a dual frequency transducer is also ongoing. The dual frequency transducer is ready for use Q3 2022.
In a project funded by The Liaison Committee for Education, Research and Innovation in Central Norway, NTNU is working together with St Olav's Hospital and SINTEF to enhance tumor uptake of chemotherapeutics in patients with pancreatic cancer by therapeutic ultrasound and microbubbles. A custom-made, dual-frequency probe for combined imaging and therapy is integrated with the Verasonics Vantage system. Publications are expected in 2023.

Several other groups are using the systems, including the Dept. of Physics and Prof. Catharina Davies, SINTEF Digital, and SURF imaging, a spin-off company from ISB led by Prof. Bjørn Angelsen.

NorMIT has been very important in conducting both experimental, preclinical, and clinical investigations of new ultrasound methods for better detection of cancer in the early stages, and also ultrasound efficacy of cytotoxic

Experimental surgery

All FOR operating rooms are authorized for experimental surgery including animal research. Such experimental procedures can be ordered at FOR who will then organize them. This arrangement is well established among clinicians and scientists. We have a “package” where FOR is organizing and planning the animal experiments in collaboration with Department of Comparative Medicine (AKM). FOR has trained and authorized personnel assisting during the whole process. Personnel who is planning or taking part in animal experiments must go through courses in animal experiments approved by the Norwegian Food Safety Authority. An important part of this course is to understand laws and regulations connected with the use of animals in medical experiments. The regulation regarding animal experiments assumes that all persons planning or performing such experiments should have passed the courses and be registered in the electronic system (FOTS) of the board for animal research. Both the responsible scientist and his co-workers involved in the practical performance of the experiments, including those who are taking care of the animals, should be included in the registration and have documentation that they have passed the course in animal experiments, category C.

We had two experimental surgeries in 2021: 26.11 and 10.12

Research Collaborations - National and international partners

Together with the Intervention Center (IVS) at Oslo University Hospital, FOR has established the national research infrastructure, NorMIT; Norwegian center for minimally invasive image-guided therapy and medical technology, with infrastructure in both Oslo and Trondheim, with several ongoing projects. The NorMIT infrastructure is available both nationally and internationally.

In 2021, we have run some projects in collaboration with partners in our own health region; Helse Midt-Norge RHF, the health register HUNT and Møre og Romsdal at Kristiansund Hospital.

SINTEF is one of FOR's most important partners. The collaboration is, among other things, built around the "National Competence Center for Ultrasound and Image-Guided Therapy". FOR also has a very good collaboration with NTNU through the MH faculty, at the Department of Circulation and Medical Imaging, Department of Energy and Process Engineering, Department of Design, Department of Mathematics, Department of Electronic Systems and Department of for technical cybernetics and the AI laboratory.

The students at the Faculty of Health Sciences at NTNU use the FOR infrastructure for projects related to the bachelor's and master's degrees in collaboration with FOR. Various competence centers such as the "National center of competence for ultrasound and imaging" and the "National center for advanced laparoscopic surgery", NTNU Technology Transfer (TTO), Center for interdisciplinary research in space (CIriS) are important partners, and it is important to maintain the synergy effect of this collaboration.

Furthermore, FOR has good cooperation with a number of industrial partners, for example: GE, Sony, Medtronic, Brainlab, Intuitive, Siemens, Stryker, Karl Storz, IBM, Apple, Olympus, Ortomedic, Smith & Nephew, Infiniwell, Aviant, ZimmerBiomet and Telenor. This is to name a few. Good practice and guidelines for cooperation with industrial partners have been developed together with experts in this area.

FOR has established joint research projects with several international partners, where we investigate the effect of new treatment methods on technological solutions and decisions made in the operating room. We want to collaborate on the effective use of ICT in the operating rooms to optimize workflow and patient flow.

Cooperation with several other international partners has been established over the years. FOR also collaborates with organizations such as the European Association for Endoscopic Surgery (EAES), Society for Minimally Invasive Therapy (SMIT), Norway Health Tech, Nordic Proof, Norwegian Smart Care Cluster and Technoport in Trondheim.

Research and development in collaboration with SINTEF

The Operating Room of the Future (FOR) is the arena and infrastructure provider for several ongoing research projects, including many projects in collaboration with SINTEF and NTNU. At SINTEF, FOR collaborates closely with Research Group for Medical Technology, at the SINTEF Digital institute, Department for Health Research. The Medical Technology group at SINTEF constitutes approximately 30 research scientist, about 20 of them are working on or in relation to projects at FOR and MiDT (The newly established National Research Center for Minimally Invasive and Image-Guided Diagnostics and Therapy, at St. Olavs hospital, FOR). The 20 researchers at SINTEF all have PhDs in related fields to medical imaging (ultrasound), medical image analysis and/or image-guided interventions (diagnostics and therapy). Some of them have collaborated with St. Olavs Hospital since 1995, at the time of establishing the previous National Advisory Unit for Ultrasound and Image-Guided Therapy (www.USIGT.org).

SINTEF is a key research partner in the new MiDT center and in FOR. Thomas Langø at SINTEF/St. Olavs Hospital is leading the new MiDT center and was also the previously the coordinator for USIGT. The new MiDT is a merging of three previous national advisory units. In addition to USIGT, fMRI (National Advisory Unit for Functional MR Imaging) and NSALK (the National Advisory Unit for Advanced Laparoscopic Surgery) are part of the new center.

One of the most important activities in 2021 was, apart from a continuation of the running projects at the four clinical areas, the planning and start-up of the new center MiDT.

MiDT carries out many projects in FOR, i.e., using it as an arena for a number of clinical and technological research, development and innovation projects, ranging from technology development, prototyping and clinical trials / studies of new solutions to improve patient care. In 2021 there were more than ten PhD projects in progress at different clinics and at SINTEF/NTNU, three of them finishing successful in 2021, and one on-going Postdoc research project. About half of these have a workplace at SINTEF, having a shared position between SINTEF and NTNU. Often, a technologist and a clinician are working together on PhD projects related to the same clinical application, illuminating the problem from both a clinical and a technological perspective. There were published about 20 scientific papers with peer review at USIGT (now MiDT) in 2021, many from projects conducted at FOR, St. Olavs Hospital. From 2022, the new MiDT center is organised at FOR.

Through several user-driven projects supported by the Research Council and EU, the collaborative group at SINTEF / St. Olavs Hospital / NTNU unit has been an important competence environment for innovation and industrial cooperation in the field of medical technology. The center has a broad national and international network and extensive activity related to the development and dissemination of expertise and knowledge, one of the core tasks of the center. Through participation in several EU projects like the previous (finished) VECTOR, IIIOS, FUSIMO, MISTELA, RASIMAS, TRANS-FUSIMO, HiPerNav, and currently on-going projects like IDEAR, MIREIA, and MEDITATE, important expertise from international academic environments has been “imported”, while at the same time generating and contributing to the spread of local expertise both nationally and internationally. SINTEF and St. Olavs Hospital also applied for EU projects in 2021 which did not receive funding, but the experience from these proposal developments are crucial to network development and future possibilities for the research group in Trondheim.

The new MiDT research center focuses on competence fields built up in the previous national advisory units. In the description from the Ministry of Health and Care Services in Norway, the fields of focus for the new MiDT center are:

- minimally invasive therapy and allied technologies
- medical imaging, focus on ultrasound and MRI
- image analysis, including artifical intelligence
- image-guided diagnostics, therapy, intervention, including robotics
- technology enhanced learning (simulator based training)

The clinical areas of focus are vascular surgery, endovascular treatment, neurosurgery, laparoscopic and flexible endoscopic surgery, pulmonary medicine and radiology/urology. In addition to the use of ultrasound, navigation, visualization, image analysis using deep learning techniques (artificial intelligence) and decision support are also important fields of research in the center and in collaboration with SINTEF / NTNU.

Software research platforms like CustusX and FAST, developed and maintained by SINTEF/NTNU, are available as an open-source software packages (at: www.CustusX.org and fast.eriksmistad.no) to the research community. Through collaboration in NorMIT with the Interventional Centre at the National hospital in Oslo, these platforms are expanded with the planning and intraoperative guidance software platform of NorMIT (www.normit.no). The purpose is to make the diagnosis better and

the treatment safer and more targeted. These platforms are disseminated nationally through the NorMIT infrastructure and internationally as open-source software in the form of customized versions for clinical applications. An example of the latter is Fraxinus (based on CustusX), a project that will create and distribute a free software package for bronchoscopy guidance (particularly the planning phase) and thus making the diagnosis of lung lesions more robust with the ambition of a higher success rate in sampling suspicious lesions in the peripheral parts of the lungs.

The activity of the national research center is a good example of how FOR can support research, development and testing of new medical technology and methods, while strengthening national and international cooperation, including industry. In addition, FOR contributes with expertise related to courses and publishing popular science articles in close cooperation with SINTEF. SINTEF also brings considerable expertise into the collaboration and utilizes its basic funding for strategic efforts to develop new technology for minimally invasive surgery / therapy.

Thomas Langø
Chief Scientist, Medical Technology
Dept. Health Research, SINTEF
and Future OR, St. Olavs Hospital
Photo: SINTEF

Scientific production

Bachelor degrees – completed in 2021

Faculty of Medicine and health sciences, NTNU Bachelor`s degree program Nursing

Anders Undrum	"Have nursing students well enough knowledge base to take care of obese patients?"
Ingeborg Pukstad	"Nursing and technology expertise; What can they learn from each other?"
Karoline Stranden	"Knowledge, misconceptions and attitudes among health professionals in meeting with the patient who undergoing obesity treatment"
Mathias Ulvesli Nord	"Overweight, obesity and stigma: A study in nurses' attitudes towards patients with overweight and obesity"
Nora Pettersen Daldorff	"Overweight and obesity;A nursing need for increasing the knowledge about overweight and obesity?
Stine Eline Skulstad	"To what extent do the nursing students and nurses knowledge base influence attitudes and nursing towards overweight and obese patients?"


Anders Undrum


Ingeborg Pukstad


Karoline Stranden


Mathis Ulvesli Nord


Nora P Daldorff


Stine Eline Skulstad

Photo: Private

Master degrees - finished in 2021

Airflow distribution in an operating room – data collection and experimental study

Frida Josefine Heggebø
Photo: Private

There is always a risk of surgical site infection and postoperative complications for patients undergoing surgery. Therefore, it is essential to understand the transportation of particles in an operating room. During the COVID-19 pandemic, negative pressure operating rooms have been investigated to prevent virus spread from the operating room to adjacent areas. The investigations have shown promising results regarding protecting the surgical staff from patients infected by COVID-19. However, the particle transportation, both to the patient and the surgical staff in an operating room with positive and negative pressure difference, is unclear and needs more research.

An operating room laboratory with mixing ventilation, different pressure differences, and different setups is used to perform experimental measurements with N2O tracer gas. The aim of this study is to determine the particle transportation from the floor level of the operating room laboratory and to distinguish the ventilation effectiveness in the same laboratory. Different cases with negative and positive pressure differences in the operating room laboratory will be studied. The operating room laboratory is compared with real operating rooms at St. Olavs Hospital. Several similarities regarding size, airflow rate, air change rate, and placement of supply and exhaust ducts indicate that the experimental measurements performed in the operating room laboratory are reliable and apply to real operating rooms.

The results of the experimental measurements illustrate that the pressure difference has an impact on the ventilation effectiveness and particle transportation in the operating room laboratory. In addition, a plate between the head surgeon and the operating table influences particle transportation. The results imply that a negative pressure difference and a plate between the head surgeon and the operating table and in the operating room laboratory is the best option to prevent particle transportation from the floor to the wound area of the patient and the surgical staff.

Kim Patrick Chrugchang Røtnes

In his master's thesis, Kim explored new methods for understanding the importance of identity in organizations through Activity Theory. He focused on mergers and acquisitions to highlight the role of organizational identity in change-situations and for different organizational cultures. The motivation for his choice of thesis was a deep desire to help managers and HR functions better understand change and integration processes from the bottom up, so that they can better take into account the organization members' many different perspectives in a demanding time. He was further inspired by a desire to understand the sociocultural factors behind so many failed change processes and mergers that happen today.
Supervisor: Roar Stokken

Kim Patrick Chrugchang Røtnes
Photo: Private

Postdoctoral staff affiliated with FOR

Erik Smistad, Postdoc ISB, NTNU / Researcher SINTEF

Erik Smistad is working mostly with automatic image analysis of real time ultrasound images, preoperartive MR and CT images, and whole slide images in digital pathology.
Finding structures such as blood vessels, nerves and tumors in images automatically in real-time can be useful in many applications such as diagnosis, pre-operative planning and ultrasound and intra-operative guidance. His main research interests includes: image segmentation, machine learning and neural networks, parallel and GPU processing and ultrasound.

Erik Smistad
Photo: NTNU

PhD degrees - Ongoing

Geir Arne Tangen
”Enhanced Minimally Invasive Therapy”. Technological PhD candidate.
The purpose of the project is development and testing of methods for integration of navigation technology in endovascular procedures. This involves accurate match between image information presented to the operator and catheter/guidewire movements inside patient’s vascular anatomy.

Supervisors: Petter Aadahl, Toril A. Nagelhus Hernes and Frode Manstad-Hulaas

Geir Arne Tangen
Photo: SINTEF

Kent Are Jamtøy
Project title: Botulinum toxin type A blocked by sphenopalatin ganglion in chronic pain and inflammatory conditions of the craniofacial region.

Innomet is a research group based at St. Olavs hospital and the Norwegian University of Science and Technology (NTNU) in Trondheim. A new method of blocking ganglion sphenopalatinum (SPG) with botulinum toxin type A (BTA) has been developed. This is done using a navigation-based instrument (MultiGuide) to ensure accurate deposition of BTA. The method has been usedin 10 patients with headache pains using transnasal access under the anesthesia.Endoscopic block of the sphenpalatine ganglion is investigated in intractable cluster headache. A pilot study on chronic migraine has also been published, where the injection is done with lateral access (through the cheek). This study also shows acceptable side effects and good potential for effect. In addition, there is also a pilot study on the injection of botulinum toxin against SPG by trigeminus neuralgia. In this PhD project, Jamtøy will inject botulinum toxin against SPG from chronic rhinosinusitis with nasal polyps and atypical facial pain. Jamtøy plans to complete his research with a 50% position over 6 years

Kent Are Jamtøy
Photo: NTNU

Javier Pérez de Frutos, PhD candidate SINTEF/NTNU

Javier is working on a PhD project with title: “Intraoperative registration techniques for improved ultrasound-based navigation in laparoscopic soft tissue surgery.” It is a technological PhD linked to the HiPerNav EU project (an ITN project under the MSCA program). Oslo University Hospital is coordinating the project and among the partners are SINTEF and NTNU. In Trondheim the project overlaps and is linked to the Laparoscopy project at the new MiDT research center at St. Olavs hospital where he is using one of the Future ORs. Javier plans to finish his PhD and defend it in 2022/23.

Javier Pérez de Frutos
Photo: SINTEF

Yang Bi

“Energy efficient airflow distribution methods for surgical microenvironment control in operating rooms”.

The design of indoor air distribution system of operating rooms (OR) is a complex task due to the strict requirements of indoor environment parameters on which there is no global consensus.The purpose of this PhD project is to explore energy efficient indoor environment control and airflow distribution methods enabling safe surgical microenvironment in ORs.

To achieve this goal, many tasks should be accomplished. Firstly, an evaluation system should be established to help designers directly evaluate the comprehensive effect of air distribution systems in ORs. Secondly, a well-performed air distribution system in ORs should be developed, optimized, and validated. Finally, a new model/tool of virtual reality should be developed to visualize the indoor environment together with St. Olavs Hospital.

Yang Bi
Photo: Private

The main method of the research is the combination of simulation and experiments. The experiments will be carried out in the laboratory of NTNU and a real OR of St Olavs Hospital. CFD simulations will be performed to validation and optimization of the air distribution system.

The results of this study will provide a solid scientific basis for ventilation design in ORs. Visualization tools will help designers better analyze CFD results.
Supervisor: Prof. Guangyu Cao

Erik Nypan
Photo: Private

Erik Nypan
Three-Dimensional Visualization and Navigation in Endovascular Procedures
Abdominal aortic aneurysm (AAA) can be treated minimally invasive by stent graft insertion endovascularly. Endovascular treatment is not possible for all aneurysms depending on anatomy, but more advanced stent grafts allowing fenestrations or branches through the graft is becoming increasingly prevalent. Image fusion, which allows high-definition pre-operative imaging to be used intraoperatively, is introduced in the last years. The aim of this project is to facilitate better and easier endovascular navigation in endovascular aortic procedures, potentially leading to more patients being treated by endovascular methods as well as a reduction in x-ray radiation and use of contrast media, which can be toxic to the kidney. The project has several sub studies, and consists of studies conducted on phantoms, animal models and in patients. An integral part of the project is to study the feasibility of combining preoperative imaging to the patient on the operating table. With the help of position sensors integrated into instruments, it is possible to record position data inside the patient. The position data may then be registered to the preoperative imaging and can be used for navigation. Together with medical student Håvard Ulsaker and with help from FOR, we have in 2020-21 utilized 3D printed models to try to correct for tissue deformation that occur during the procedure. Erik successfully defended his thesis for PhD in 2021.
Main supervisor: Frode Manstad-Hulaas
Assistant supervisor: Reidar Brekken

Andreas Østvik

Andreas Østvik
Photo: Private

Project title: Automatic analysis of medical ultrasound using machine learning
The goal of the PhD project is to utilize and further develop machine learning methods to improve state-of-the-art solutions in the field of ultrasound image analysis and visualization. More specifically, research is conducted on automating pipelines for clinical measurements in echocardiography, with motivation of improving robustness and workflow. This involves classification of images, quality assurance, semantic segmentation and landmark extraction, as well as integrating these components for quantitative measurements. Andreas successfully defended his thesis for PhD in June, 2021.
Supervisor: Lasse Løvstakken, ISB, NTNU

Arne Kildahl-Andersen

Arne Kildahl-Andersen
Photo: Private

PET and advanced ultrasound in navigated bronchoscopy
The project is part of the activity in the research group LUNA – Lung Navigation (part of the National Competence Center for ultrasound and image-guided treatment) which is a collaboration between SINTEF, NTNU and St. Olavs Hospital. The group has long track record with electromagnetic navigation integrated in the bronchoscope. Together with the project group, Arne will continue to work on ultrasound bronchoscopy integrated with electromagnetic navigation and PET-CT. A clinical trial of Fraxinus, a navigation software for virtual bronchoscopy will be performed. In addition, Arne will explore the possibilities for improved diagnostics of peripheral lung tumors by combining ultrasound and navigation. Additionally, Arne has been involved in testing Hololens based visualization during bronchoscopic procedures. Both phantom tests as well as a pilot study on one patient have been carried out.
Main supervisor: Håkon Olav Leira

Masab Khalid Annaqeeb

Masab Khalid Annaqeeb
Photo: NTNU

Simulation of Energy/related Occupant Behavior in Buildings
The focus of the doctoral research work is on developing occupant behavior (OB) models, to be used in building simulation. In order to improve the understanding of OB, its drivers and influencing factors, the models will be developed in different domains, taking into account the multidisciplinary aspect of OB. To achieve that, the work includes collection of behavioral data with regards to the occupant's surrounding layouts, movement, social influences, and energy-use habits. The collected data is being used to develop databases, and agent-based models to simulate OB in buildings.
Supervisor: Prof. Guangyu Cao

Medical Student`s Research Program, Faculty of Medicine and Health Sciences, NTNU

At the Faculty of Medicine and Health Sciences, NTNU, a separate research programme has been established around the ordinary curriculum of medicine. The research programme involves two additional semesters devoted only to research, and that research is organized in parallel with the medical curriculum.
The research programme is an offer for medical students interested in research and a possible future research career, possibly in parallel with clinical activities.
Admission to the research programme takes place after two or three years of medicine studies at NTNU. From the autumn of 2002, the research programme was established at all four medical faculties in Norway, based on a wish to recruit more medical students to research, improving the organization of research education, and promoting scientific attitude for the practise of medicine.

Håvard Ulsaker

We perform a national multicenter study to assess patients that are treated with endovascular aortic repair (EVAR) for thoracoabdominal aortic aneurysms (TAAA). Open surgery for TAAAs are comprehensive operations, and mortality rates have been reported as high as 20% in small volume centers. Many patients are deemed too high risk to undergo open surgery. Recent years' advancement in endovascular techniques have made it possible to treat TAAAs with an endovascular approach. In the study we assess the short and medium term outcomes in patients treated with branched EVAR (t-Branch, Cook Medical) at the Norwegian centers. Patients from all four university hospitals in Norway are included. Mortality, complications and comorbid data are compared with that of open repair patients.

We have also conducted a study in which we compared outcomes in patients treated with the t-Branch and custom-made devices (CMDs) at St. Olavs Hospital. The t-Branch is a standard off-the-shelf stent graft system suitable in 60-70% of TAAAs, while CMDs are patient specific to suit individual patient's aortic and visceral vessel anatomy. The study showed low 30-day mortality, acceptable technical success rates, high medium-term survival, and no significant differences in clinically relevant outcomes between t-Branch and CMD patients.

Additionally, we work with SINTEF on electromagnetic navigation in endovascular procedures. Specifically, we assess how 3D-printed aortic aneurysm models deform during insertion of endovascular equipments, such as stiff wires and stent graft delivery systems. By taking the in-procedure aortic deformation into account, we hope to improve the navigational accuracy of the electromagnetic tracking system.

https://www.sciencedirect.com/science/article/pii/S2666688X22000302

Main supervisor: Frode Manstad-Hulaas
Assistant supervisors: Reidar Brekken and Arne Seternes

Håvard Ulsaker
Photo: Norsk medisinstudentforening

Hedda Skogum Riise
The two projects MigriNor and Headache-map are both focused on serum concentration measurements of prophylactic treatment used for primary headache disorders. In the smaller project Headache-map, we aim to investigate adherence to prophylactic treatment for all the headache-disorders. This is done by taking blood samples from patients visiting the outpatient clinic, measuring the serum concentration of the drug claimed to be in use. MigriNor is an observational study where we do a four-month follow-up of migraine patients initiating prophylactic treatment. The follow-up contains one month baseline before initiating treatment and three months after initiation. After initiation, we collect information about effects, adverse events, as well as blood samples measuring the serum concentration for the prophylactic drug in use. The aim is to describe dose-effect-relationships and potentially be able to use serum concentration measurements to guide decision making and dose regimens in the follow-up of these patients. The studies are currently ongoing and open for inclusions.
These projects are a collaboration between the department of neurology and pharmacology. The main supervisor for my project is Tore Wergeland Meisingset (MD, PhD). Co-supervisors are Melanie Rae Simpson (MD, PhD), Erling Tronvik (MD, professor) and Ketil Arne Espnes (MD, senior consultant).


Hedda Skogum Riise
Photo: Private

Other projects

An important part of the mandate of The Operating Room of the Future is to develop and promote research and development projects in the intersection between scientists, health care personnel and industry. The aim is to create new and original knowledge with new solutions which are useful for the patients. We are in the intersection between science and innovation – between creation of new knowledge and new solutions and their application in daily clinical practice. The collaboration with various clinical disciplines is important to make sure those new solutions, methods, processes and new knowledge is introduced in clinical routine. We have our own infrastructure for the testing of new medical technology and new treatment modalities to create and maintain the bridge between new knowledge and well known routine. FOR has an extensive collaboration with national and international industry through research and development projects.

The effects of tourniquet on muscle strength and function in patients operated with total knee arthroplasty and a multicenter prospective cohort study on Persona total knee system
About 5000 total knee arthroplasties (TKA) are performed annually in Norway. Pain and reduced physical function are present in patients operated with TKA up to a year after surgery and about one of five patients are not satisfied with the outcome from TKA surgery. The use of tourniquet during surgery to minimize hemorrhage, may have impact on pain and physical function. Whether TKA surgery should be performed with or without the use of tourniquet, is a much-

debated issue in orthopedic surgery today, and there is still no consensus in this field. The overall aim of this project is to improve knowledge about the effects of tourniquet vs. no tourniquet on pain, muscle strength and function and thereby improve patient satisfaction. The results from the project might have implications for rehabilitation and the outcome after TKA surgery. This project will investigate early muscle strength and power recovery, neuromuscular recordings, neuronal changes and patient reported outcome measures. 80 patients will be included in this randomized controlled study. The patients are also invited to participate in a multicenter study which evaluates patient- reported outcome measures and ssurvival after TKA using the Persona total knee system. All patients have been included in the study.
The study is initiated by Zimmer Biomet.

The effect of altered hip biomechanics on physical function, quality of life and pain after hip fracture surgery

Henrik Alexander Runde
Adequate restoration of preoperative femoral offset (FO) is critical for successful outcome in patients with osteoarthritis receiving total hip arthroplasty, but the literature is scarce concerning its influence on outcome following hip fractures. Reduction of the FO after fixation with dynamic osteosynthesis decreases the moment arm for the abductor muscles of the hip. Leg-length discrepancy (LLD) may also be readily perceived after surgery and may affect clinical outcomes and patient satisfaction. Although the mechanical physics in the joint apply in the same way, hip fracture patients represent a noticeably different patient group. Specifically, other factors may play a greater role, such as frailty, comorbidity and dementia. To what extent biomechanical factors determine the functional outcome following hip fracture treatment in a representative cohort is still not clear in the literature of orthopaedic trauma. The aim of the project was to investigate the relationship between specific joint biomechanical parameters and 1-year functional outcome scores in a general cohort of patients with hip fracture.

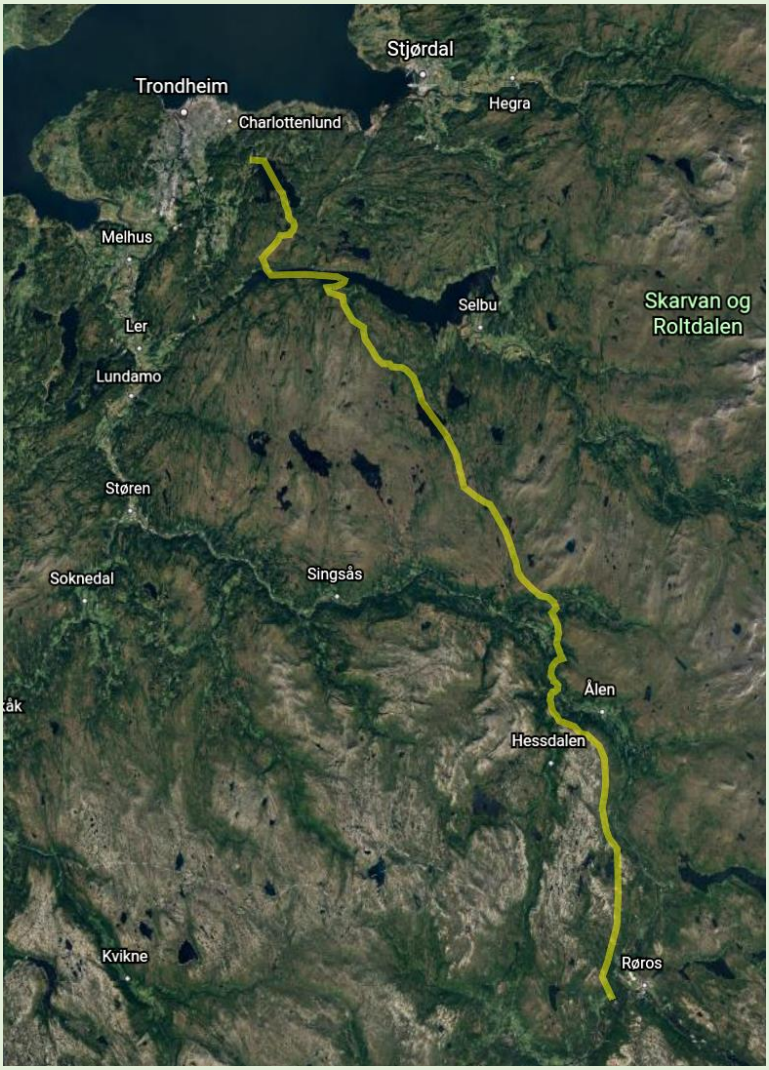
We conducted an observational cohort study in a consecutive series of 117 patients that underwent surgery for hip fracture. Patients were contacted and invited to a follow-up clinical investigation involving pelvic radiographs. A total of 54 patients participated at the 1-year follow-up and were completely analysed. We measured alternation in FO and LLD on the plain anteroposterior pelvic radiographs. Outcome were assessed by Trendelenburg test, Harris Hip Score (HHS), Short Physical Performance Battery (SPPB), EuroQol 5-dimension 5-level (EQ-5D), EQ-VAS (visual analogue scale measure of quality of life) and numeric rating scale (NRS) for pain in the affected hip. Relationships between patient characteristics, radiographic measures and functional outcomes were investigated.Our study could not demonstrate any effect of change in FO on physical function, quality of life or pain. Subtle benefits may not have been revealed due to limited sample size. Further research is required to see if our findings apply to other patient samples. Femoral offset alteration and leg-length discrepancy is common following treatment for a hip fracture, especially after internal fixation. More knowledge on the subject is clinically relevant and might be used to improve the physical function and quality of life of this vitally important group of patients.

Henrik defended his Medical Student Research Thesis in October 2021. As a doctoral research fellow at INB, he is continuing the research on older adults with hip fracture with regards to the impact of cognitive function on physical activity, physical performance and quality of life.

Main supervisor: Lars Gunnar Johnsen
Assistant supervisors: Kristin Taraldsen and Trude Basso

Droneproject

The Operating Room of the Future ("Fremtidens Operasjonrom", FOR) has collaborated with the NTNU-based drone logistics company Aviant since September 2020. The collaboration led to the first flight from Røros to Trondheim in February 2021, marking the longest autonomous drone flight conducted in Scandinavia (120 KM). The event received national press through DN.no and NRK, and international press through the Massachusetts Institute of Technology (MIT) homepage. The success of the first flight proved the technology feasible and regulations mature and laid the foundation for future work on drone-based logistics in Trøndelag.



In 2022, FOR was granted innovation funding for the LuftVei project in collaboration with Aviant AS. The collaboration has resulted in transporting 80 biological samples and over 40 trips by drone from Røros to Trondheim, as well as transporting surgical equipment and consumables. As far as we know, this is the first medical payload flown over such long distances in Norway with a drone. LuftVei has received a lot of media attention, including on NRK Kveldsnytt1. The project has also given Helse-Midt a leading position in using drones in Health-Norway and is now leading an application for the Research Council's Pilot Health in collaboration with hospitals from Helse Nord, Helse West, and Helse South-East.

This year's project has demonstrated that drone transport in the health service can improve response times to biological samples because they can be used when needed and are faster than traditional transport alternatives. Thus, the regular test transport by car, which only runs once a day, will no longer represent a bottleneck for the Hospital in Røros. The result of this is faster treatment times for patients. Shipping of surgical equipment and consumables by drone also helps to increase the availability of resources in hospitals. Drones are a need-based solution that can deliver

up to four times faster than alternative transport solutions, in addition to cutting transport costs by 90% and reducing emissions of greenhouse gases by 95%.

FOR's experience with drones has thus positioned Central Norway Regional Health Authority as the leading professional environment within drone logistics in the Norwegian healthcare sector. The projects have proven the technology mature, and regulations open for more advanced use cases with drones. The project has also documented the negative and positive impacts of using this new transportation medium. We will continue to pay attention to this new method of mobility within the healthcare sector with a great interest in how it can be deployed in the future.

Courses arranged by FOR

Electro-medical equipment (EMU) - courses arranged in 2021:

10th of January: EMU-course for Departement of orthopedic surgery

- High energy equipment
- Endoscopy
- Irradiation protection and use of C-arm for fluoroscopy

Scientific articles 2021

Tapentadol vs oxycodone for postoperative pain treatment the first 7 days after total knee arthroplasty: a randomized clinical trial. Pain. 2021 Feb 1;162(2):396-404. doi: 10.1097/j.pain.0000000000002026.
PMID: 32773594 DOI: 10.1097/j.pain.0000000000002026, Torbjørn Rian, Eirik Skogvoll, Janne Hofstad, Lise Høvik, Siri B Winther, Vigdis Schnell Husby, Jomar Klaksvik, Tarjei Egeberg, Kari Sand, Pål Klepstad, Tina Strømdal Wik.

A Simple and Novel Method to Predict the Hospital Energy Use Based on Machine Learning: A Case Study in Norway. *Communications in Computer and Information Science* 2020 ;Volum 1332. s. 11-22
NTNU STO, Xue, Kai; Ding, Yiyu; Yang, Zhirong; Nord, Natasa; Barillec, Mael Roger Albert; Mathisen, Hans Martin; Liu, Meng; Giske, Tor Emil; Stenstad, Liv-Inger; Cao, Guangyu.
A Simple and Novel Method to Predict the Hospital Energy Use Based on Machine Learning: A Case Study in Norway | SpringerLink

Suitability evaluation on laminar airflow and mixing airflow distribution strategies in operating rooms: A case study at St. Olavs Hospital
Building and Environment (IF 4.971) **Pub Date : 2021-02-12** *, DOI: 10.1016/j.buildenv.2021.107677*
Minchao Fan, Guangyu Cao, Christoffer Pedersen, Shilei Lu, Liv-Inger Stenstad, Jan Gunnar Skogås.

Suitability evaluation on laminar airflow and mixing airflow distribution strategies in operating rooms: A case study at St. Olavs Hospital - ScienceDirect

Influence of the surgical team activity on airborne bacterial distribution in the operating room with mixing ventilation system: A case study at St. Olavs Hospital*, Journal of Hospital Infection (14 August 2021)*
https://doi.org/10.1016/j.jhin.2021.08.009lMasab KhalidAnnaqeeb1,YixianZhang2,Jakub WladyslawDziedzic1,KaiXue3,ChristofferPedersen4,Liv-IngerStenstad5,VojislavNovakovic1,GuangyuCao1

Influence of the surgical team activity on airborne bacterial distribution in the operating room with mixing ventilation system: A case study at St. Olavs Hospital - ScienceDirect

Can clothing systems and human activities in operating rooms with mixing ventilation systems help achieve 10 CFU/m3 level during orthopaedic surgeries?
Guangyu Cao, Christoffer Pedersen, Yixian Zhang, Finn Drangsholt, Andreas Radtke, Håkon Langvatn, Liv-Inger Stenstad, Hans Martin Mathisen, Jan Gunnar Skogås
PII: S0195-6701(21)00402-3
DOI: https://doi.org/10.1016/j.jhin.2021.11.005
Reference: YJHIN 6528

Can clothing systems and human activities in operating rooms with mixing ventilation systems help achieve 10 CFU/m3 level during orthopaedic surgeries? - ScienceDirect

Sonopermeation Enhances Uptake and Therapeutic Effect of Free and Encapsulated Cabazitaxel
Sofie Snipstad, Yrr Asbjørg Mørch, Einar Sulheim, Andreas Åslund, André Pedersen, Catharina de Lange Davies, Rune Hansen, Sigrid Berg
Ultrasound in Medicine and Biology

Tapered Vector Doppler for Improved Quantification of Low Velocity Blood Flow
Ingvild Kinn Ekroll, Vincent Perrot, Herve Liebgott, Jørgen Avdal
IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control

Translation of Simultaneous Vessel Wall Motion and Vectorial Blood Flow Imaging in Healthy and Diseased Carotids to the Clinic: A Pilot Study
Vincent Perrot, Ingvild Kinn Ekroll, Jørgen Avdal, Lars Mølgaard Saxhaug, Håvard Dalen, Didier Vray, Lasse Løvstakken, Herve Liebgott
IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control

Effect of Acoustic Radiation Force on the Distribution of Nanoparticles in Solid Tumors
Mercy Afadzi, Ola Finneng Myhre, Petros T. Yemane, Astrid Bjorkoy, Sverre Helge Torp, Annemieke van Wamel, Sylvie Lelu, Bjørn Atle J. Angelsen, Catharina de Lange Davies
IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control

ISB:
Snipstad, Sofie; Mørch, Ýrr; Sulheim, Einar; Åslund, Andreas; Pedersen, André; Davies, Catharina de Lange; Hansen, Rune; Berg, Sigrid. Sonopermeation enhances uptake and therapeutic effect of free and encapsulated cabazitaxel. Ultrasound in Medicine and Biology 2021 ;Volum 47.(5) s. 1319-1333 https://doi.org/10.1016/j.ultrasmedbio.2020.12.026

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Live streaming and high-resolution recording in the operating room

NorMIT has built expertise and technology related to recording, broadcasting and live transmissions from the operating room. This means that today we are able to perform high quality live streaming from all operating rooms at St. Olavs Hospital in a cost-effective way without the need for a permanent installation. The production systems we use are mobile solutions that are easily rigged in the operating room and in the conference auditorium. With access to high-speed internet, live surgery and other medical procedures can be shared rapidly with colleagues internally as well as globally. Cost effective transfers and recordings of all forms of medical procedures are now possible, regardless of surgical specialty. We transfer both images and support two-way sound from the operating room to the lecture hall. We also perform recording of the live transfer so that it can be reviewed afterwards.

In 2021 FOR provided the broadcasting support for a workshop arranged by the Gynecology Department at St.Olavs Hospital in collaboration with Normedi AS. The gynecology department from Vestfold hospital visited the workshop to learn how St. Olavs Hospital has enabled to perform certain procedures in polyclinic rather than surgically. Each participant of the workshop had the chance to take part in the procedure beside the doctor performing the treatment, and also to follow the procedure via live broadcasting of images from multiple sources and sound to a different room. The feedback from senior consultant Ingrid Volløyhaug at the Gynecology department at St. Olavs hospital was very good. All participants were impressed with the quality of the broadcast, and certain aspects of the procedure was easier to understand via broadcast rather than taking part in the treatment room. The combination of live participation and live broadcast was a perfect solution, and will be used for future workshops at the department.

FOR in media

https://www.mn24.no/nyheter/i/aWLXW7/trondheim-na-kan-hjertet-ditt-sjekkes-over-5g

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